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

(34) Max KG-PU(t) = {[Starting ATP-P(t) * 12 * 30 * PDA-P]

+ [New ATP-P(t) * 3 * 30* 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];

[13] An unknown proportion of these involved other 'drug labs' and were not specifically marihuana grow-op related.

- [Plecas et al (2005)] estimated that residences used for marihuana production 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 residences used for marihuana production[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.

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, 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;

[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

[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.

- 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 production 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 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 marihuana production 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 marihuana production 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
- Construction design/installation act or omission fires (Design/Install): have a lower (59%) death rate (than for all fires), a lower (67%) injury rate and higher (109%) property damage per fire.

All the above statements are relative to the same base (i.e. all fires).

Assuming that these three circumstances of interest are statistically independent, it is possible to compute the factors associated with a 'compound situation' having all three of these circumstances of interest. In other words, fire parameters can be estimated for 1- & 2- family residential dwellings where the ignition source is electrical and there is a construction design/installation deficiency. These are the circumstances of most concern for fire safety related to marihuana production misuse situations.

Table 4.5 shows the fire data specific to these circumstances of interest. The compound probability of 0.14% (i.e., a fire of this type given any kind of family dwelling fire), the specific rates of death per fire (0.0028) and injury per fire (0.0252) and average property damage per fire ($37,903) generate estimates that there would have been, nationally for Canada for an annual average over the five year period 1998-2002, 78 such fires corresponding to this compound set of circumstances and 0 deaths, 4 injuries and about $3.0M in cumulative property damage per year.

Table 4.5 – Residential Marihuana Cultivation
Relevant Fire Parameters

Estimated Annual Fires	78	
Probability	0.14%	Number
Rate of death per Fire	0.0028	0
Rate of injury per Fire	0.0252	4
		Total Damage
Property Damage per Fire	$37,903	$2.956M

Source: Delsys calculations based on CCFMFC data for selected years.

In the calculation of deaths, these estimates were rounded to the nearest integer value.

Although the estimates were rounded to the nearest integer, the calculation of injuries in the CBA model took into account the 'rounding difference' that arises from the death calculation. Therefore, if the estimate of deaths is 0.3 and this was rounded down to 0.0, the rounding error (i.e., 0.3 minus 0.0) was added to the estimate of injuries before rounding for injuries. In essence, this is equivalent to saying that 0.3 deaths means zero deaths, but means an extra 0.3 injuries. This was taken as an intuitively proper way for dealing with 'integer lumpiness' in this aspect of the CBA model.

The above data was used in the CBA to represent the probabilities of injury, death and property damage per fire caused by marihuana production "misuse-like" conditions.

4.4.2 Misuse of Residential Marihuana Cultivation

A review of alleged MMAR 'misuse' cases (n=190) shows that there were 23 cases (12%) where electrical hazard was mentioned [RCMP (2010)]. This suggests that the potential for a 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 illegal activity, 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 residence used for marihuana production has a twenty-four (24) times greater risk of residential fire than a regular home. As MMAR misuse involves a family residence compared to marihuana production sites that 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 production site, 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 production site.

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 production. However, it is known that they arise from all marihuana production sites, 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 fires in marihuana production sites 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 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:

(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:

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

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 marihuana production 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 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.

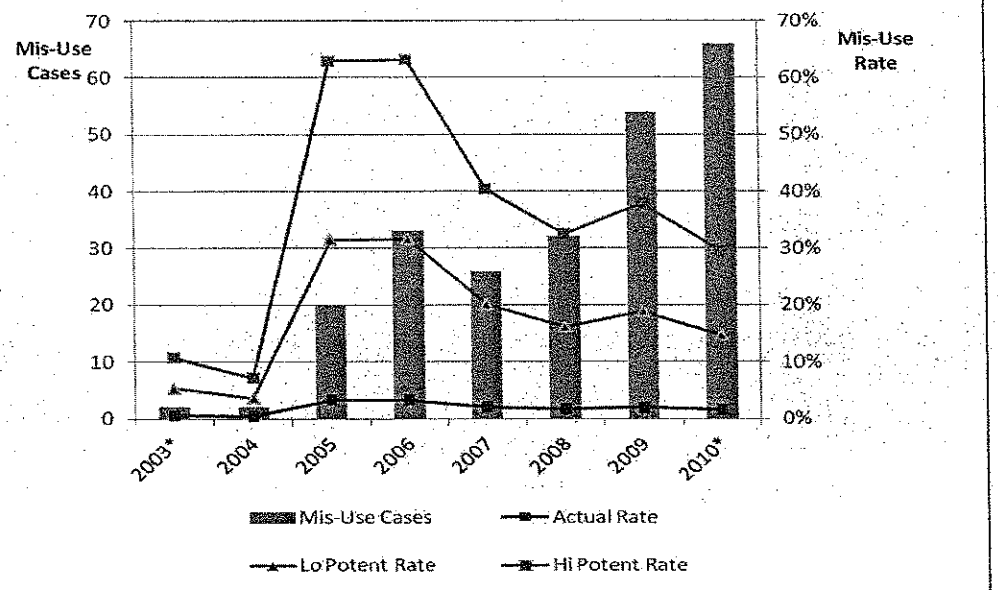
There is a low estimated rate of police detection for marihuana cultivation (i.e. grow operation). One BC study estimated this rate at 5% [Dandurand et al (2002)], while another study estimated the rate for Quebec at 2.5% [Bouchard (2007)]. If a higher (10%) rate of detection is assumed, this implies 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.

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.

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

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.

4.5.3 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)].

4.5.4 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.

4.5.5 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.

4.5.6 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.

[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.

4.5.7 Social Cost Associated with Residential Misuse – Status Quo

The social loss associated with residential misuse is given in the Status Quo scenario by:

(47) $\text{Social Loss}_{misuse}(t) = \text{ATP-P/D}(t) * Pr_{misuse} * WTP_{misuse}$

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

4.5.8 Social Cost Associated with Home Invasion – Status Quo

The social loss associated with home invasion is given in the Status Quo scenario by:

(48) $\text{Social Loss}_{invasion}(t) = \text{ATP-P/D}(t) * Pr_{misuse} * Pr_{major} * Pr_{invasion} * WTP_{invasion}$

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

4.5.9 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

4.5.10 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 regulated 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 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.

b) It generally involves a residence where people live, whereas commercial-scale illicit grow-ops involve much larger scale production than can be accommodated in a family residence also used for the benefit of the family.

Scale of Residential Misuse Marihuana Cultivation

This analysis assumed that the scale of marihuana cultivation for residential misuse is less than that for a grow-op.

The mean number of permitted plants under MMAR-PUPL, based on the mean Proposed Daily Amount of 7.6 grams, is 37 marihuana plants. These are expected to yield 30 grams of dried marihuana but also have a wastage factor of 1.2 so that the effective yield is actually 25 grams per plant per harvest. The yield is based on a 120-day harvest cycle and three (3) harvests per year. The mean PUPL producer, keeping to the maximum allowable number of plants and MMAR yield and harvest assumptions, would produce about 2.8KG of dried marihuana.

Yield per Year = Plants * Yield/Plant/Harvest * Harvest/Year

In terms of the expected actual marihuana consumption of such a person, the CBA used an estimate of about 4.2 grams per day, which comes, for 350 days per year of use, to about 1.5KG of consumption. It is possible that actual consumption accounts for the entire production or that production is scaled to meet consumption for own use.

For the 64% of persons who are not involved in any misuse, it was assumed that there is no illicit distribution of any excess production capacity. For the 36% of persons involved in MMAR misuse it was assumed that they are engaged in illicit marihuana distribution.

Minor Misuse (80%)

For 80% of misuse cases, it was assumed that that such misuse is minor in scale. As described below, some parameters were then applied to this activity to estimate the likely returns and risk associated with that activity.

Minor Misuse - Rewards

For minor misuse, this study assumed that the maximum number of plants would be kept at the legal limit (37) and that the yield would be higher (60 grams per plant per harvest) with a 90-day cultivation cycle and four (4) harvests per year. These parameters seem reasonable in relation to actual criminal evidence from grow-op activity [RCMP (2010)].

This would allow for the production of 8.9KG of dried marihuana against estimated personal consumption of 1.5KG, leaving 7.4KG of excess production available for illicit distribution. Data suggests that wholesale distribution [RCMP (2010)] by the pound generates about $2,800 (or $6.17/gram), so that the estimated sales value of the excess production is about $45,000.

This sales revenue is comparable to about half the sales revenue for a British Columbia grow operation [Easton (2004)]. Allowing the same supply cost per gram as for PUPL production generates an estimated gross margin (over costs) of about $40,000. This represents the 'reward' from criminal activity (for minor misuse).

The reference case reward for minor misuse (PUPL) is given in the Policy User Transition by:

(63) Reward-Minor = {[(Plants * Yield/Plant * Harvest/Yr) – Use/Yr]

* Wholesale Price/Gram} – Supply Cost/Yr

Minor Misuse - Risks

Probabilities [Dandurand et al (2002)] were available for the risk of detection, seizure, charges laid, conviction and receipt of fine or prison sentence. The analysis assumed various economic losses as a result of uncertain events occurring for the criminal activity. The study assumed the following values of economic loss: seizure ($50,000[23]), facing charges ($5,000[24]), fines ($1,000[25]) and prison ($9,000[26]).

An important parameter in the model is the aforementioned requirement for additional evidence as evidence of the mere presence of residential cultivation associated with an MMAR production license will generally be insufficient grounds for obtaining a warrant to search the premises. The result has been, according to law enforcement officials, that police resources are not as effective as they might be in terms of resulting law enforcement actions when there is suspected misuse of such MMAR licenses.

In the CBA model, this effect was introduced by assuming that cases of MMAR misuse faced a 2.5% probability of detection by police and that the probability of police action (given police detection) is reduced by a factor of 75% from its base probability value of 80% [Dandurand et al (2002)]. Therefore, the effectiveness of law enforcement to address MMAR misuse impacts on a lower probability of detection and a lower probability of police action, given police detection.

The analysis assumed that minor misuse does not attract home invasion and 'grow-rip' type robbery by other criminal elements as the scale of misuse is relatively minor. This risk was reserved for major MMAR misuse of residential cultivation.

Based on compound probabilities of law enforcement actions and consequences, an expected value of loss for minor misuse (PUPL) in the Policy User Transition was estimated as:

(64) $\text{Risk-Minor} = [\text{Minor-Misuse} * Pr_{detection} * Pr_{action} * (1 - \text{Enforcement Clarity}) * Pr_{found}]$

$* \{[Pr_{seizure} * \text{Loss-Seizure}] + [Pr_{report} * Pr_{charge} * \text{Loss-Charge}] +$

$[Pr_{convict} * \{(Pr_{fine} * \text{Loss-Fine}) + (Pr_{prison} * \text{Loss-Prison})\}]\}$

where

Minor-Misuse = ATP-P(Apr 2012) * 36% * 80%

[23] Based on the annual revenue * (1+.10) with an adjustment for the value of seized materials and supplies.
[24] Assumed as an inconvenience (value of time) factor with or without legal fees (which may be by a public defender).
[25] From Dandurand et al 2002.
[26] Based on 2.5 months sentence from Dandurand et al 2002 with hourly wage of $25 for 35 hours per week and 4.1 weeks per month.

$Pr_{detection}$ = probability of police detection (given misuse) = 2.5% (under MMAR)

Pr_{action} = probability of police action (given detection) = 80%

Enforcement Clarity = reduction in Pr_{action} as a result of MMAR = 75%

Pr_{found} = probability of case found (given action) = 95%

$Pr_{seizure}$ = probability of police seizure (given case found) = 100%

Loss-Seizure = expected economic loss from police seizure = $50,000

Pr_{report} = probability of report to Crown Prosecutor (given seizure) = 87%

Pr_{charge} = probability of charges laid (given report to Crown) = 98%

Loss-Charge = expected economic loss from facing charges = $5,000

$Pr_{convict}$ = probability of conviction (given charges laid) = 73%

Pr_{fine} = probability of fine imposed (given conviction) = 39%

Loss-Fine = expected economic loss from fine = $1,000

Pr_{prison} = probability of prison sentence (given conviction) = 42%

Loss-Prison = expected economic loss from fine = $9,000

In the Reference case, the expected loss from police action and criminal justice sanctions was about $270 and largely the result of police seizure.

Minor Misuse – Opportunity Cost

In addition to the supply cost of marihuana production, the analysis also accounted for the opportunity cost of time spent on criminal activity (in terms of additional cultivation time, transaction time and overhead for running of the illicit enterprise). A proportional value of this time relative to a target annual income ($60,000) for a work-year of 1,800 hours (i.e., $33.33/hour) was applied. For minor misuse this opportunity cost was roughly $4,700.

Minor Misuse – Net Expected Return

In the Reference case, the net expected return for minor misuse was about $35,800 and represents an expected rate of return of about 370% over the expected costs of activity (excluding loss from risks).

Minor Misuse – Compensation for Risk

The analysis also considered risk sensitivity, as people are generally risk-adverse. The analysis conceptualized risk sensitivity in terms of the ratio of the expected rate of return to some risk threshold rate of return, which reflects the expected value of loss from risks. The rationale is

that most people care about the absolute level of risk they bear and want a very high return to compensate them for such risk. For the purposes of the CBA, it was assumed that persons engaged in illicit activity want a minimum ten (10)-fold return to compensate them for illicit undertakings. In the reference scenario, the minimum expected return for minor misuse was estimated to be 28%.

Minor Misuse – Reward-to-Risk Multiple

In the Reference case, the expected rate of return (370%) was about thirteen (13) times higher than the minimum expected return for misuse (28%). This reward-to-risk multiple suggests that persons engaged in MMAR minor misuse would appear to be very comfortable in terms of the reward-to-risk profile (under the Status Quo scenario parameters).

If, with the Policy scenario, a marked change is seen in the reward-to-risk multiple, it would be reasonable to expect a reduction in illicit activity. This reflects a form of risk elasticity, for which it is possible to infer some value to generate behavioural change that should result from gaining more clarity under the MMAR (in terms of a higher probability of police detection of potential misuse and a higher probability of police action, given police detection).

The same calculations for major misuse, which also invites the risk of home invasion and 'grow-rip' theft by other criminal elements, are described below. The absolute dollar value of illicit reward was much higher for major misuse but the expected rate of return in the Reference case was lower (305%) and the minimum expected return for major misuse (based on the risk profile and losses) was estimated to be 128%. Therefore, the reward-to-risk multiple was much lower (2.4) for major misuse. However, this multiple is still economically attractive.

Deterrence Effect on Residential Misuse

In terms of the economically rational effect of crime prevention and deterrence on illicit activity, the analysis used a result for the US [Chang et al (2008)] which estimated that a 10% increase in the probability of criminal conviction for drug trafficking/production would decrease the number of active dealers by 0.26%. This implies a 'conviction elasticity' ($\varepsilon_{convict}$) of -0.026.

$$\varepsilon_{convict} = \%\Delta\text{persons involved in cultivation} / \%\Delta Pr_{convict}$$

Using Canadian parameters and the CBA effect of addressing the current need for additional evidence through the policy scenario (equation 62), the cumulative $Pr_{convict}$ for the Status Quo reference case is:

$$Pr^{SQ}_{convict} = Pr^{SQ}_{detect} * Pr_{action} * (1 - \text{Enforcement Clarity}) * Pr_{found} * Pr_{report} * Pr_{charge} * Pr_{convict}$$

$$= 0.296\% \text{ (for the Status Quo reference case)}$$

With the clarifying effect (removing the need for additional evidence), the Pr^{POL}_{detect} increases and results ina higher $Pr^{POL}_{convict}$:

$$Pr^{POL}_{convict} = Pr^{POL}_{detect} * Pr_{action} * Pr_{found} * Pr_{report} * Pr_{charge} * Pr_{convict}$$

$$= 2.365\% \text{ (for the Policy reference case)}$$

The impact in terms of the number of persons involved in illicit misuse (residential marihuana cultivation, formerly associated with MMAR production licenses) is given by:

(65) $\%\Delta$persons involved in cultivation = $\varepsilon_{convict} * \%\Delta Pr_{convict}$

where

$\varepsilon_{convict}$ = -0.026 * {[2.365% - 0.296%] / 0.296%}

= -0.026 * 700% = -18%

Therefore, one would expect there to be 18% fewer persons involved in residential marihuana cultivation as a result of the higher probability of detection and greater policy action effectiveness from the removal of valid MMAR residential production licenses (PUPL/DPPL).

The analysis assumed that this effect would be experienced for major misuse activity. As it is likely that persons involved in minor misuse are more risk adverse than persons involved in major misuse, the analysis assumed that the elasticity response for minor misuse would be twice (two times) that of major misuse.

Equation 62 is therefore estimated using $\varepsilon^{major}_{convict}$ = -0.026 and $\varepsilon^{minor}_{convict}$ = -0.052. These assumptions were tested in terms of the sensitivity of CBA results.

The number of persons who will cease their residential marihuana cultivation in the Policy transition (due to the clarifying effect of removing the need for additional evidence in enforcement) is given by:

(66) Cease = Misuse (major or minor) * $\%\Delta$persons involved (major or minor)

The number of persons who will continue their residential marihuana cultivation in the Policy transition (despite the 'enforcement clarity' effect) is given by:

(67) Continue = Misuse (major or minor) * [1 + $\%\Delta$persons involved (major or minor)]

Opting-Out for Residential Producers with No Misuse

The analysis also contemplated the possibility that persons who produce marihuana in the Status Quo scenario with no misuse (i.e., strictly for their own consumption) might opt out of the Policy scenario regime, and continue their own production illegally. These are people who were law-abiding in the Status Quo scenario (i.e., legal marihuana cultivation) but who might exercise civil disobedience in the Policy scenario through illegal marihuana cultivation at a small scale and without illegal marihuana distribution or sales.

In the Reference case, it was assumed that the Opt-Out Rate for such non-misuse PUPL users would be 0% (i.e. there is no civil disobedience). However, the sensitivity analysis allowed for a rate up to 20% of such persons.

The number of formerly ATP-P persons who are considered in terms of the Price Elasticity effect as still being in the market, ATP-P*, is given by:

(68) ATP-P* = ATP-P(April 2014) – $Cease_{(minor)}$ – $Cease_{(major)}$

- [ATP-P(April 2014) * (1 - .36) * Opt-Out Rate]

Once the persons who, despite the 'enforcement clarity' effect, will continue to engage in residential marihuana cultivation have been removed, the number of persons who are likely to be involved in the Transition to the new Policy regime can be calculated. It is then necessary to take into account the operation of the Price Elasticity of Demand as it affects these people.

The reference Price Elasticity of Demand ε_p = -0.25 and represents the %ΔQuantity in response to a %ΔPrice (ceteris paribus[27]). The situation of the regulatory change involves more than just an effective price change, as it represents a policy change and declaration of a formally legal activity as illegal. As discussed above, persons who were formally (and legally) cultivating marihuana for their own use (with no misuse) are expected to cease this activity as it is no longer considered legal. The analysis separately allowed for some Opt-Out Rate.

The %ΔPrice experienced by these users is given by:

(69) %ΔPrice-P = [LP-Price – Own Supply Cost] / Own Supply Cost

which, for an initial LP Price of $7.50 and an Own Supply Cost of $1.80, gives a %ΔPrice-P of 317%.

The operation of the price elasticity is given by:

(70) %ΔQuantity-P = ε_p * %ΔPrice-P

The %ΔQuantity-P in the reference scenario is -79%. As the Status Quo scenario initial quantity demand (Personal Use) was 41,365KG, this means that the Policy Transition Quantity-P (after the price elasticity effect) will be 8,618KG (i.e. 41,365 * (1 + %ΔQuantity-P).

It is then necessary to assign this %ΔQuantity-P to either %ΔUser-P or %ΔQuantity/Day-P, and to again check to see if the Status Quo Quantity/Day is affordable in relation to Mean Annual Income (as in equation 54).

The Quantity per Day in the Policy scenario, for persons who were on Personal-Use Supply (as of April 2014) is calculated as:

(71) Quantity/Day-P = MIN{4.18, [Mean Annual Income * Max % of Income / 350

/ $7.50]}

In the Reference case, the effective minimum for Quantity/Day-P is 1.7 grams per day. This means that, relative to the Status Quo Quantity/Day-P (4.18 grams), the %ΔQuantity/Day-P is -59%.

[27] Ceterus paribus (roughly 'all other things unchanged') is the assumption used in partial equilibrium analysis.

The number of User-P is calculated as:

(72) User-P = MIN{(ATP-P*), [(Quantity-P * 1,000) / (350 * Quantity/Day-P)]

Where

ATP-P* from equation 68

Quantity-P is the resulting quantity demanded after the operation of the Price Elasticity of Demand; and

Quantity/Day-P is the result from equation 71.

It is then possible to calculate the %ΔUser-P as [(User-P – Base User-P) / Base User-P]. In the reference scenario, the %ΔUser-P is -49%.

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-P who will transition to the LP market at the higher LP market price of $7.50 per gram, would be expected to be:

(73) Base KG-P(Market Price) = ATP-P*(April 2014) * (1 + %ΔUser-P) * 350 * Quantity/Day-P

The number of users in the Policy scenario, for persons formerly in Personal-Use Supply (as of April 2014) is calculated as:

(74) Users-P(Market Price) = ATP-P*(April 2014) * (1 + %ΔUsers-P)

Equations 73 and 74, therefore, 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 Personal-Use Supply.

4.7.4 Policy Transition – Designated Person

The analysis considered a transition model for Designated-Person use in a similar manner. Here the situation differed slightly, as the persons consuming the marihuana are different from the persons producing the marihuana. The same reasoning (logic and equations) holds for such persons engaged in DPPL production. Here again it was assumed that the mean DPPL producer supplies for two ATP-D persons. The number of allowable marihuana plants is higher (44), as the Proposed Daily Amount mean is higher (9.0 grams).

Equations 63-67 apply for DPPL producers, resulting in an estimate of the number of persons who cease and continue producing marihuana. Although it not possible to know if the locus of production is a residence, for the purposes of the CBA of safety and security benefits this assumption is made for simplicity.

The number of persons who will cease their residential marihuana cultivation in the Policy transition (due to the law enforcement effect) is given by:

(75) Cease = Misuse (major or minor) * %Δpersons involved (major or minor)

The number of persons who will continue their residential marihuana cultivation in the Policy transition (despite the law enforcement effect) is given by:

(76) Continue = Misuse (major or minor) * [1 + %Δpersons involved (major or minor)]

When the shift is made from DPPL producers to ATP-D consumers, it is not possible to assume that the consumers whose producer is prepared to supply them illicitly will continue to source their marihuana requirements from these illicit producers. This is not an automatic result, as producers and consumers in the DPPL/ATP-D relationship may have different preferences, risk tolerances and other characteristics. The analysis assumed that all persons who held ATP-D authorizations would seek legal sources of supply.

The number of ATP-D persons who were considered as potential Policy scenario users (ATP-D*) was calculated as:

(77) ATP-D* = ATP-D(April 2014)

The price elasticity effect was then applied to these persons.

In the reference case, the %ΔPrice-D is 142% (from $3.10 to $7.50 per gram) and the operation of the Price Elasticity of Demand (ε_p = -.25) requires that the %ΔQuantity-D is -35%. This %ΔQuantity-D must then be assigned to either %ΔUser-D or %ΔQuantity/Day-D. Then, a check must be made to see if the Status Quo Quantity/Day is affordable in relation to Mean Annual Income (as in equation 71). Generally, the same result (as for Personal Use) will apply, so the Quantity/Day-D is 1.7 grams per day, which is a -59% change from the Status Quo scenario.

As the percentage change arising from the affordability condition (-59%) exceeds the required Price Elasticity of Demand required change in quantity demanded (-35%), there is no required change in the number of users (i.e. %ΔUsers-D = 0%). The affordability condition demands that the price response actually exceeds the ε_p = -.25 requirement. This is why the price elasticity in the Policy scenario often exceeds that for the Status Quo scenario.

As above (for ATP-P transition), the analysis estimated the base annual quantity of marihuana (in KG) that would be consumed in the Policy scenario, for the expected number of persons with ATP-D who will transition to the LP market at the higher LP market price of $7.50 per gram, to be:

(78) Base KG-D(Market Price) = ATP-D*(April 2014) * (1 + %ΔUser-D) * 350 * Quantity/Day-D

The Number of Users in the Policy scenario, for persons formerly in Designated-Person Supply (as of April 2014) is calculated as:

(79) Users-D(Market Price) = ATP-D*(April 2014) * (1 + %ΔUsers-D)

Equations 78 and 79, therefore, 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 Designated-Person Supply.

4.7.5 Policy Transition – All Users

It is possible to compute, based on the behavioural responses of producers and consumers, what the base level of demand (at an expected Market Price of $7.50/gram) would be across all users and taking into account the likely continued misuse/desire to continue illicit marihuana production and the likely operation of a price elasticity of demand. This gives a first look at the scale of the LP market demand (as of April 2014).

The base annual quantity of marihuana (in KG) that would be consumed in the Policy scenario, for all persons expected to transition to the LP market at the expected LP market price of $7.50 per gram is given by:

(90) Base KG(Market Price) = Base KG-GS + Base KG-O + Base KG-P + Base KG-D

The Number of Users in the LP market at the expected LP market price of $7.50 per gram is given by:

(91) Users(Market Price) = Users-GS + Users-O + Users-P + User-D

The scale of the expected LP market (as of April 2014) at an expected LP market price of $7.50 per gram is 19,385KG for 32,623 users, each consuming a mean of 594 grams per year (or 1.70 grams per day for 350 days per year) at an annual user cost of $4,460. This is the Reference case that was used to estimate the evolution of the LP market over time in the Policy scenario.

The analysis calculated an Implied Price Elasticity, based on the transition from the Status Quo to the Policy scenario and taking into account the options to 'opt-out' of the Policy Regime by illicitly cultivating marihuana for own use.

(92) Transition ε^{*}_{p} = {[KG(Market Price) - KG(User Cost)] / KG(User Cost)}

/ {[Market Price - User Cost] / User Cost}

where

KG(Market Price) = Base KG-Demand at LP Market Price (April 2014)

KG(User Cost) = Base KG-Demand at User Cost (as in Status Quo) (April 2014)

Market Price = $7.50/gram * 1,000 (this study's assumed estimated LP Market Price)

User Cost = $2.60/gram * 1,000 (from weighted average in Status Quo)

The last value is a weighted average of User Costs from ATP-GS, ATP-O, ATP-P, and ATP-D who all face different User Costs in the Status Quo scenario.

For the Reference case, the value of the Implied Price Elasticity is -0.36. This is higher than the initial Price Elasticity-Status Quo assumption (-0.25) as it explicitly allows for choosing to 'opt-out' of the Policy Regime. For the purposes of estimating Consumer Surplus in the Policy scenario, the analysis estimated the Intercept-D (Price Intercept of the Demand Curve) using the Price Elasticity of Demand which is computed in the Policy Transition model.

The Implied Grams Per Year-Policy is estimated using the KG (Market Price) and Users (Market Price) as:

(93) Grams/Year-POL = KG(Market Price) * 1,000 / Users(Market Price)

Implied Annual User Cost-POL is estimated as:

(94) Annual Cost-POL = Grams/Year-POL * Market Price

The Implied Grams Per Day-Policy is estimated using the Implied Grams Per Year-Policy as:

(95) Grams/Day-POL = Grams/Year-POL / 350

4.8 Policy – Demand Curve

The analysis again assumed that the Demand Curve is linear in the Policy scenario, the same assumption used in the Status Quo scenario. From the Transition Model (April 2014), an initial point on the Demand Curve-Policy was estimated, based on an expected LP Price of $7.50/gram.

The equilibrium LP Market Price is known when both a Demand and Supply curve estimate for the LP Market (Policy scenario) are obtained.

1. *Demand Curve – Intercept*

From equations 90 and 91 there is a point on the Demand curve (in April 2014) of (Market Price, KG(Market Price)) or ($7,500, 19,385) when expressed as a Price/KG and KG-Demand. The calculated Price Elasticity of Demand (Policy) is -0.36. As above (equations 27 and 28), it is therefore possible to estimate, for a linear Demand curve, the Intercept-D and Slope-D.

The Demand curve intercept in the Policy scenario is given by:

(96) Intercept-D = Market Price * [1 – (1.0 / ε^{*}_{p})]

As there are now two points of the Demand curve (the y-axis intercept) and the estimated transaction point (Market Price, Base KG) the Demand curve slope (which is negative as the curve is downward-sloping) can be calculated.

2. Demand Curve - Slope

The Demand curve slope (for the Policy scenario at April 2014) is given by:

(97) Slope-D(April 2014) = [Market Price – Intercept-D] / KG(Market Price)

For the Reference case, these values are: Intercept-D = $28,335 and Slope-D = -1.07. It is known that, as the market expands in scale over time, the value of the Slope-D will fall (in absolute terms) in order to be linear with a constant Price Elasticity over time. This was the case for the Status Quo model.

The Demand curve for the LP Market assumed an instantaneous switch from the Status Quo to the Policy scenario as of April 2014. This is unrealistic, as the complexity of Policy Transition would likely occur over a 6- to 18-month period. As the CBA is intended to look at the long-term (10 year) 'steady state' impact of the Policy scenario, the complexity of the actual transition process is ignored for simplicity.

The model logic and results must now be applied from the Policy Transition to forecast the future evolution of Potential Demand Users over time.

From the Policy Transition, it was estimated that 15% of ATP-Persons in April 2014 would 'opt out' of the new Policy regime and access their marihuana from illicit sources, mostly from own-production that is now illegal (i.e., 6,844 Users 'Opt Out' from 47,123 assumed ATP-Persons).

From the Policy Transition, it was estimated that 16% of ATP-Persons in April 2014 would be 'priced-out' of the new Policy regime at the estimated LP Market Price of $7.50/gram (i.e., 7,656 User 'Priced Out' from 47,961 assumed ATP-Persons[28].

These probabilities were used as a constant over time to remove persons from the stream of Potential Policy User*, which is given by:

(98) $\text{Policy User}^*(t) = \text{Policy User}^*(t-1) + \{\text{New Entrants}(t) * [1 - Pr_{optout}] * [1 - Pr_{priceout}]\}$

where

New Entrants(t)	= ATP(April)(t+1) - ATP(April)(t) for April values of ATP numbers in the Status Quo over time between any two Fiscal Years.
Pr_{optout}	= the probability of Potential Policy Users to 'opt-out' of the Policy regime
$Pr_{priceout}$	= the probability of Potential Policy Users to be 'priced-out' of the Policy regime

[28] This study applies the 'price-out' effect against an estimated Market Price of $7.50 per gram. Subsequently, in a model of demand/supply equilibrium in the LP market, the study will determine an equilibrium price which may be greater than $7.50 per gram. The analysis does not estimate a further price elasticity effect should the equilibrium price be greater than $7.50 per gram. This was done to segment the analysis and provide simplicity.

In order to compute the Demand curve Slope over time, for the Policy scenario, it is necessary to estimate some position on the Demand curve over time. There is the constant Intercept-D which we calculated from the implied (constant) Price Elasticity of Demand. This analysis estimated a point associated with $7.50/gram LP Price, which was the Reference case price used in the Policy Transition Model. This will not necessarily be the Equilibrium Price when the LP Demand and Supply curves are allowed to intersect.

The KG-Demand in the LP Market, over time and at the estimated LP Market Price of $7.50/gram, is given by:

(99) $KG\text{-}Demand^{*}(t) = Policy\ User\text{-}FY^{*}(t) * Grams/Day\text{-}POL / 1{,}000$

where

$Policy\ User\text{-}FY^{*}(t)$ = FY average of monthly values determined over time based on April values for successive years.

The Demand curve slope (for the Policy scenario), over time, is given by:

(100) $Slope\text{-}D(t) = [Market\ Price - Intercept\text{-}D] / KG\text{-}Demand^{*}(t)$

As for the Status Quo, the Slope-D(t) declines in absolute value over time as the market expands.

The parameters for the Demand curve (LP Market) over time are given in equation 96 (for constant Intercept-D) and in equation 100 (for time variant Slope-D(t)).

This analysis now turns to the LP Supply Model.

4.9 Policy – Supply Curve

A detailed activity-based costing (ABC) model was built for LP Supply production based on various parameters from the literature, and estimates that are comparable to the Government Supply (Status Quo) production, where these are appropriate.

It was assumed, except for the role of the Incumbent Supplier, that an LP entrant would have a beginning scale of operation of 500KG production. This can change in the actual Supply model and is used as a fixed target for the purposes of supply costing.

LP-Scale = 500KG

4.9.1 LP Production – Supply Cost Model

LP-Production Component

It was estimated that the number of production workers per KG produced is 0.072 FTE, based on reported data in the press (2006) about production at the Government Supply. The Scale = 500KG would require about 36 production workers.

LP-PROD = 0.072 FTE Production Workers / KG-Supplied

It was estimated that the production facility could support about 5 plants per m^2 of production space.

LP-PM2 = 5 Plants per m^2 of Production Space

It was estimated that a marihuana plant produces 33.6 grams/plant/harvest for 4 harvests per year, or 134 grams/plant/year.

LP-GPP = 134 grams / Plant / Year

The production space requirement to achieve the LP-Scale output, in terms of m^2 of production space, can be determined by:

(101) Production Space = LP-Scale / [LP-GPP * LP-PM2 / 1,000]

For the parameters assumed, this results in about 745m^2, or about 8,000ft^2 of production facility. In order to allow space for: a) storage and drying; b) worker change/toilets/day-use; c) secure delivery/pick-up; d) administration; e) maintenance/cleaning supplies; and f) miscellaneous needs, the production requirement was effectively doubled to get an overall estimate of the required facility size.

(102) Production Facility = Production Space * 2

It was estimated that a suitable production facility could be obtained for about \$9.00/ft^2, including Net Lease and TMI (taxes, maintenance and insurance)[29]. Therefore, the annual Production Facility Cost (LP-PFC) is given by:

(103) LP-PFC = Production Facility * \$9.00

which is about \$144,000 per year for the assumed LP-Scale.

It was estimated that production supplies are about \$85/m^2/harvest for growing medium and other sundry supplies (excluding electricity).

LP-SUPP = \$85/m^2/harvest

It was estimated that electricity requirements are 40 watts/ft^2, which, converting to metric for 24 hours per day for the LP-Scale, and converting to KWH, with electricity cost of \$0.04/KWH, gives:

LP-ELEC = \$146/m^2/year

Variable labour cost (production workers) was estimated at about \$35,000/year (based on \$15/hour for 1875 hours and EBP Cost Factor of 1.25).

[29] The \$9.00/ft^2 estimate was developed for Toronto Industrial locations (Canadian Property Management website). While these costs may be higher or lower by geographic area, this estimate is used for the reference scenario.

LP-LAB = $35,000/year

Production equipment costs are $120/m^2/year in relation to production space, based on amortized cost.

LP-EQUIP = $120/m^2/year

Production security costs are $20,000/year in relation, based on amortized costs for various security requirements and unit costs (e.g., entrance, fence, detection/alarm systems, IT security).

LP-SEC = $20,000/year

Total Production Costs, for the LP-Scale facility, is found by sum of various production cost items:

(104) Production Cost = LP-PFC + [LP-SUPP * Prod-Facility * Harvest]

+ [(LP-ELECT + LP-EQUIP) * Prod-Facility]

+ LP-LAB + LP-SEC

Production cost of about $1.9M is estimated for the LP-Scale production.

LP-Order Processing Component

Average shipment size is estimated to be 50 grams.

The number of annual shipments is given by:

(105) LP-SHIP = LP-SCALE * 1,000 / 50

which is 10,000 in the reference case. This would work out to about 40 shipments per working day (for 50 weeks/year and 5 working days per week). Some peak demand is allowed in the analysis so that the workforce is assumed to accommodate up to 1.5 * Average Orders/Day = 60 shipments/day.

It is estimated that an Order Clerk can process 10 Orders per day, so to accommodate the peak order there is a need for 6 FTE Order Clerks.

LP-ORD = [(LP-SHIP / 250) * 1.5] / 10

The same Annual Salary cost is assumed for Order Clerks ($35,000).

The Courier Cost per Shipment is estimated to be $50.

LP-COUR = $50

Order and Shipping Costs are therefore given by:

(106) Order/Ship = [LP-ORD * $35,000] + [LP-COUR * LP-SHIP]

An order/shipping cost of about $0.7M is estimated for the LP-Scale production.

LP – Corporate Component

There are a total of 36 production works and 6 order clerks. It was assumed that there is a Supervisor Span of Control of 12, so that the number of Supervisors is given by:

(107) LP-SUP = (LP-PROD + LP-ORD) / 12 (rounded to nearest integer)

It is assumed that Supervisors are paid 1.65 times the salary of Production/Order workers.

It is assumed that there are 1.35 Corporate Managers/Executives per $1M in sales revenue. For the LP-Scale that implies 5 Corporate Managers. It is assumed that these Managers earn $90,000 annually.

LP-EXEC = $450,000/yr

It was estimated for 12 Corporate Staff the requirement for Corporate Office space for about 4,600ft^2 at a commercial lease cost of $14.00/ft^2/yr.

The Corporate HQ Space Costs were estimated at $65,000/year.

LP-HQ = $65,000/yr

Corporate Security/IT and Equipment Costs were estimated at $30,000/year.

LP-IT&S = $30,000/yr

Corporate Costs are therefore given by:

(108) LP-CORP = [LP-SUP * $35,000 * 1.65] + LP-EXEC + LP-HQ + LP-IT&S

Corporate Costs were estimated at about $0.8M for the LP-Scale production.

LP – Total Operating Cost

LP-Total Operating Costs are the sum of Production, Order/Shipping and Corporate Costs.

(109) LP-OPER = [LP-SUP * $35,000 * 1.65] + LP-EXEC + LP-HQ + LP-IT&S

It was estimated that Total Operating Costs, for the LP-Scale production, would be $3.4M per year.

LP – Net Margin (EBIDT)

LP-Net Margin (Earnings Before Interest, Debt and Taxes) is given by:

(110) LP-NET = [LP-SCALE * $7.50 * 1,000] - LP-OPER

and the % Net Margin is LP-NET / LP-REVENUE (first part of right-hand side of above equation). In the reference scenario, this results in LP-NET = $390,000 and %Net of 10%.

LP – After Tax Profit

It was estimated that LP interest costs and taxes would be about $105,000, so that after-tax profit is about $285,000, or 8% of Revenue.

By definition, as the analysis has fully exhausted the revenue, the total cost (per gram or KG) is the same as the sales revenue (per gram or KG).

Table 4.6 summarizes the LP Supply Cost model. This is not presented as a reliable guide to LP costing, but as an order-of-magnitude cost estimate that corresponds reasonably well to Health Canada expectation that the LP Market Price could be in the vicinity of $7.50/gram.

In Table 4.6, the LP supply cost works out to $6.72/gram, which, in a market after HST is applied (at 13%), would give a user price of roughly $7.60/gram.

Table 4.6 – Policy – LP Supply Cost		
Model 2.20 LP Parameters (Initial Scale for LP)		
LP-Small Scale (KG)	500	
Target Revenue - Small	$3,750,000	
Production Site Workers	36.0	
Production Space Requirements		
Plants / m^2	5	
Yield / Plant / Year (grams)	134	
Yield / m^2 / Year (grams)	672	
Grow Space Requirement m^2	744	
Grow Space ft^2	8,000	
Storage / Drying ft^2	1,600	20%
Worker Facility ft^2	800	10%
Secure Delivery Space ft^2	1,200	15%
Administration ft^2	1,600	20%
Maintenance/Cleaning ft^2	1,200	15%
Other/Misc. ft^2	1,600	20%
Total Production Facility ft^2	16,000	
Ratio of Grow / Total Space	50%	
Production Facility Cost/Year	$144,000	
Cost per m^2 Grow Area	$194	
Production Facility Value	$1,920,000	
Variable Cost Parameters		
Supplies per m^2 / harvest	$85	
Supplies per m^2 / year	$340	
Supplies per / year	$252,976	
Electricity KwH per m^2 / year	3,650	
Electricity KwH / year	2,715,774	
Electricity Cost / year	$108,631	
Electricity Cost per m^2 / year	$146	
Labour Hours per KG	135	
Labour Hours / year	67,500	
Labour Cost / year	$1,260,000	
Labour Cost per m^2 / year	$1,693	
Equipment Cost / year	$89,286	
Equipment Cost per m^2 / year	$120	
Physical Security Requirements		
Security Cost / year	$20,000	
Security Cost per m^2 / year	$27	
Production Cost Sub-Total		
Total Production Costs / year	$1,874,893	
Total Production Costs / m^2 / year	$2,520	
Total Production Costs / KG	$3,750	
Order Processing		
Average Shipment Size (gram)	50	
No. Shipments / Year	10,000	

Table 4.6 – Policy – LP Supply Cost	
No. Shipments / Day	40
Peak Shipments / Day	60
Shipments / FTE / Day	10
Peak FTE Requirement	6
Order Proc Labour Cost / year	$210,000
Labour Cost / Shipment	$21
Courier Cost / Shipment	$50
Courier Cost / year	$500,000
Management & Overhead	
Operational Staff FTE	42
Supervisors FTE	4
Supervisors Cost	$231,000
Corporate FTE	5
Corporate Staff Cost	$450,000
Corporate Space m^2 per FTE	28
Corporate Staff	12
Corporate Overhead Space m^2	93
Corporate Space m^2	429
Corporate Space ft^2	4,618
Corporate Space Cost/Year	$64,648
Corporate Security Cost/Year	$10,000
IT/Equipment Costs	$20,000
Order/HQ Cost Sub-Total	
Total Order/HQ Costs / year	$1,485,648
Total Order/HQ Costs / KG	$2,971
Operating Cost Sub-Total	
Total Costs / year	$3,360,541
Total Costs / KG	$6,721
Operating Margin	$1,644,107
% Operating Margin	44%
EBIDT	$389,459
% Net Margin	10%
Working Capital Requirement	$616,438
Debt Load	$750,000
Interest Cost	$42,329
EBT	$347,130
Taxes	$62,483
Profit After Tax	
Earning After Tax	$284,647
% After-Tax Profit on Revenue	8%

Sources: Delsys Research

This LP costing model provides some support for believing that an LP Market could be operative in FY2014-15 at around $7.50/gram.

4.9.2 LP – Compliance Cost

The TBS Regulatory Cost Calculator was used with an activity-costing model for specific policy regulatory requirements to derive an estimated Business Compliance Cost of $20M on an annualized basis for the LP market entrants. This was estimated to involve Fixed Compliance Costs (per year) of $322,160 per LP and Variable Compliance Costs of $62,476 per LP based on the scale of the LP operation.

This study developed a Scale Factor(t) over time based on the KG-Supply in the LP market over time and made adjustments to the Fixed Compliance Cost as additional LPs entered the market.

The LP Compliance Cost was estimated in the Policy scenario to be:

(111) LP-COMP = {Fixed Cost * #LP(t)} + {Variable Cost * Scale Factor(t)}

where

#LP(t) = the number of LP entrants at time t

Fixed Cost = $332,160 per LP

Variable Cost = $62,476 per LP (when Scale Factor = 1.00)

Scale Factor(t) = KG-Supply(t) / KG-Supply(2014-15) which is a value between 1.0 and 6.44 over time

In the reference case, the LP compliance costs represent about 11% of Revenue (FY2014-15) and fall to 3% of revenue (FY2013-14).

4.9.3 LP – Supply Curve

It was not possible to derive the Supply curve Intercept or Slope directly from the LP costing model (above). The Supply curve represents the impact of a (possibly) lower marginal cost Incumbent, and the introduction of LP Entrants with higher marginal costs. It was expected that the Supply curve would have an upward slope, reflecting the fact that market expansion draws in LP entrants, at the margin, who may be less efficient and have higher marginal costs.

The following heuristic rationale was posited for the Supply curve parameters.

It is not anticipated that there would be any LP Market supply at a price (per KG) below $6,000. Effectively, it is believed that the Incumbent's marginal cost is at least $6,000/KG.

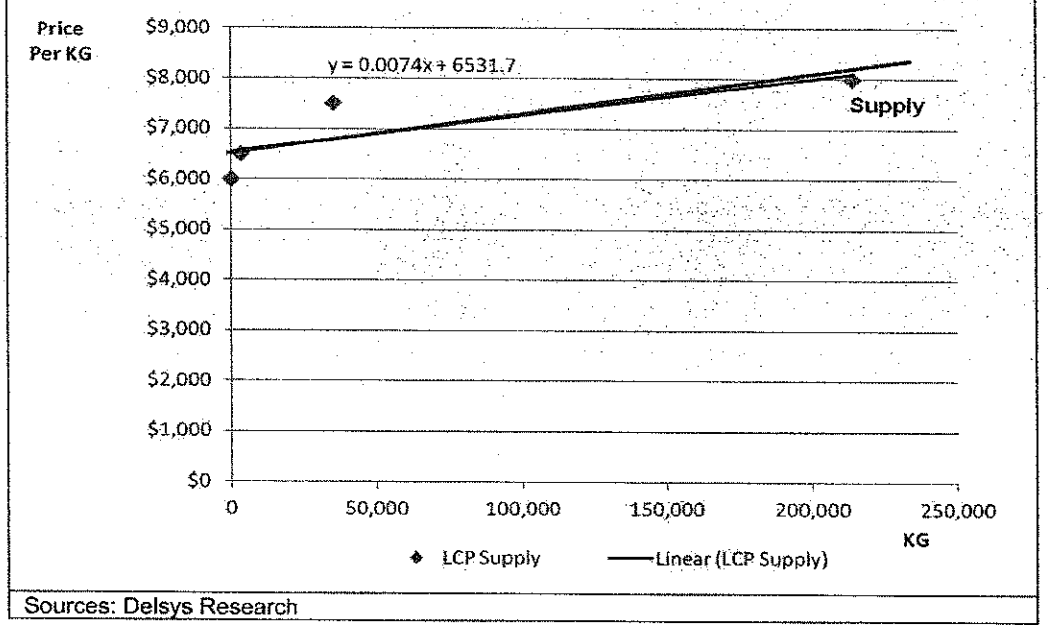
It is estimated that the Incumbent could supply, perhaps, 3,500KG, at a marginal cost (Price) of $6,500.

It is estimated that a scaled Incumbent and about 50 LP Entrants (at the LP-Scale used in the Costing Model) could supply 35,500KG at a Market Price of $7,500/KG.

It is estimated that a scaled Incumbent and, perhaps, 400 LP Entrants could supply 200,000KG at a Market Price of $8,000/KG.

These are heuristic estimates. When these points are graphed and used to estimate a Linear Regression line in the supply space (Figure 4.11), an estimate of the Supply curve is obtained.

Figure 4.11 – Supply Curve - LP Market
Based on Heuristic Logic



Sources: Delsys Research

Supply – Intercept & Slope

Based on this heuristic reasoning, an Intercept-S of $6,500 and a Slope-S of 0.0074 are estimated. These will be fixed over time in the model.

Intercept-S = 6,500

Slope-S = 0.0074

This study will analyze the sensitivity of the CBA results to these parameters. When analyzing this sensitivity, the Intercept-S is allowed to vary and the Slope-S is calculated so that there is always a fixed point at (P=$6,722, Q=30,000). Effectively, there is allowance for the Supply curve to 'swivel' around that fixed point, which establishes the April 2014 position in the LP Market.

Now that the Demand and Supply curve parameters are obtained and are linear in form, it is straightforward to determine the Market Equilibrium (Price, KG) at any point in time in the model.

One additional factor taken into account is the 'tax wedge' that HST introduces between the Market Price (User) and Market Price (Supplier). The existence of HST means that, at any point in time in the Policy scenario,

(112) Market Price(User)(t) = Market Price(Supplier)(t) * (1 + HST)

where it was assumed, for simplicity, a single HST rate for all provinces/territories of 13%.

4.10 Policy – LP Market Equilibrium

The two equations for Supply and Demand in this analysis are:

Supply-P = A + B * KG (i.e. A=Intercept-S, B=Slope-S)

Demand-P = C + D(t) * KG (i.e. C= Intercept-D, D(t)=Slope-D)

In equilibrium, the KG are the same in the two equations and Demand-P = (Supply-P * 1.13). Rearranging and solving for KG-Equilibrium:

(113) KG-EQ(t) = [C - 1.13A] / [1.13B - D(t)]

This equation is used to determine KG-EQ(t) over time. The Supply equation is then used to determine Supply-P(t) over time.

In the FY2014-15, the reference scenario gives:

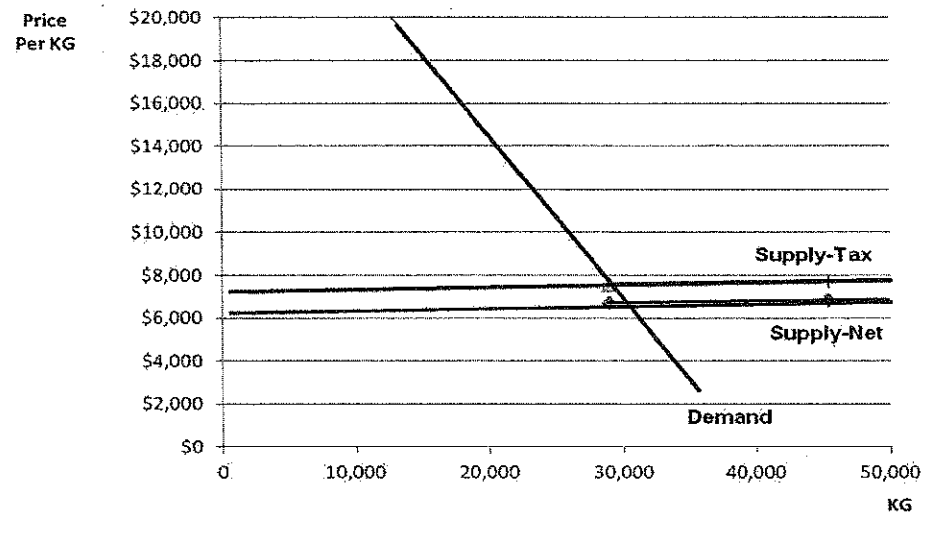
KG-EQ = 26,731 KG

P-EQ-Supply = $6,698/KG

P-EQ-Demand = $7,569/KG

These are shown in Figure 4.12.

Figure 4.12 – Equilibrium - LP Market (2014-15)



Sources: Delsys Research

Initially, in the Reference case, it was anticipated that the LP Market could be supplied by a Scaled Incumbent and 50 New LP Entrants. The analysis allows additional LP Entrants to enter the market in FY2016-17 and in FY2018-19 if the market capacity utilization ratio is sufficiently close to 85% over the average of the next four years. It is assumed that once LP Entrants join the market they scale their production from the Base-Scale of 500KG annually to about 4,000KG annually by 2024-25.

4.11 Policy – User Benefits & Costs

Consumer Surplus – LP Market

Consumer Surplus is estimated in a similar manner to equation 32 (for Government Supply).

The existence of the HST tax wedge means there is a Deadweight Loss associated with the LP market and it is necessary to separately track the Supply Price (P*S-EQ) and Demand Price (P*D-EQ) as well as the Equilibrium Quantity (with Tax) (KG*-EQ) for various calculations. It is also necessary, for the Deadweight Loss calculation, to calculate the Price ($P^{\#}$-EQ) and Equilibrium Quantity (no Tax) ($KG^{\#}$-EQ).

Consumer Surplus (LP Market) over time in the Policy scenario is given by:

(114) CS(LP)(t) = 0.5 * [Intercept-D - Demand Price(t)] * KG*-Demand(t)

Producer Surplus – LP Market

Producer Surplus (LP Market) over time in the Policy scenario is given by:

(115) PS(LP)(t) = 0.5 * [Supply Price(t) - Intercept-S] * KG*-Demand(t)

Deadweight Loss – LP Market

Deadweight Loss is estimated in a similar manner to equation 33 (for Government Supply).

Deadweight Loss (LP Market) over time in the Policy scenario is given by:

(116) DWL(LP)(t) = {0.5*[$P^{\#}$-EQ(t) - Supply Price(t)] * [KG*-EQ(t) – $KG^{\#}$-EQ(t)]}

+ {0.5*[Demand Price(t) – $P^{\#}$-EQ(t)] * [KG*-EQ(t) – $KG^{\#}$-EQ(t)]}

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

4.12 Policy – Safety Costs

It was estimated in the Reference case of the Policy Transition Model (for April 2014), that 8,000 producers (PUPL/DPPL) might 'opt out' of the Policy regime and continue cultivation, illicitly and principally in their family residence. This was modelled in equation 63-67. This was a reduction of 33% in misuse by persons who held production licenses.

It was also known that about 60% of persons who are interested in accessing marihuana for medical purposes are prepared to undertake own-production. This is a historical fact in the MMAP experience.

It was also estimated, in equation 98, that the number of persons that would enter the new Policy regime, based on the number of persons who would have participated in the MMAP in the Status Quo scenario. The analysis used the number of persons who would have participated in the MMAP as the base against which to estimate the continued stream of persons who will continue to engage in misuse in the Policy scenario.

4.12.1 Policy – Residential Misuse

The number of persons who will continue to grow marihuana in their family residence in the Policy scenario who were, counterfactually, related to MMAP in the Status Quo scenario, is given by:

(117) Misuse(Policy)(t) = 7,605 (for April 2014)

(118) Misuse(Policy)(t) = Misuse(Policy)(t-1) + [MMAP-New Entrant(t) * 0.6 * (1 - .33)]

where

MMAP New Entrant(t)		= the number of persons who would enter MMAP in the Status Quo
Pr(PUPL)	=	0.6
%Misuse Reduction	=	0.33

It is important to highlight that this study does not assume that all residential cannabis/marihuana cultivation would cease as a result of the Policy changes. Effectively, the operation of the crime prevention/deterrent effect of clarification (through the removal of the need for additional evidence) is only assumed to reduce such activity by 33%. It may be that the actual impact will be higher, but this study modelled the response based on evidence in the literature dealing with drug crime prevention.

The analysis assumed, as for the Status Quo scenario, the same parameters for minor and major misuse, fire risk, injury and death rates, economic loss from injury, death and property damage. Therefore, equations 44 to 46 are effectively used to estimate the same losses associated with fire to obtain Fire Costs for the Policy scenario.

4.12.2 Policy – Fire Costs

For each of the fire events associated with misuse, the social costs associated with fires related to marihuana cultivation are given, in the Policy scenario over time, by:

$$(119)\ \text{Fire Costs}(t) = [\text{House Fire}(t) * WTP_{damage}] + [\text{House Fire}(t) * Pr_{injury} * WTP_{injury}] + [\text{House Fire}(t) * Pr_{death} * WTP_{death}]$$

as in equation 46.

4.13 Policy – Security Costs

The misuse stream, over time, in the Policy scenario, as given in equation 118, is also used as the primary input into the Security model which otherwise uses the same parameters and logic as equations 47 to 51 for the Status Quo.

Crime Prevention Benefits & Costs

One intended consequence of the proposed Policy is to improve public security by removing from residential areas the locus of licensed marihuana cultivation.

Attribution of crime prevention benefits is made difficult by the presence of the 'displacement effect'. This is defined as the unintended increase in targeted crimes in other locations following from the introduction of a crime reduction scheme. Five different forms of displacement have been identified [Reppetto (1976)]: a) temporal (change in time), b) tactical (change in method), c) target (change in victim), d) territorial (change in place), and e) functional (change in type of crime).

Effectively, the attribution of benefits to crime reduction must be able to document logically (and with evidence, preferably) that the reduction of crime is not localized in time, space, location or type of crime and merely displaced elsewhere. If such displacement occurs there is no (or less) social welfare gain.

Crime reduction/control benefits arise from:

a) savings of resources for law enforcement activity; and

b) reduced societal harm (i.e. willingness-to-pay (WTP) to avoid harm or willingness-to-accept' (WTA) harm).

The elimination of the option to personally produce marihuana for medical purposes under Health Canada regulation is a main feature of the intended improvement in public security outcomes. Such a policy will only have an impact to the extent that the underlying activity is stopped or reduced in level. To the extent that this activity remains (at the same level) and becomes illicit (without cover of the MMAR), there would be no social welfare change. This is an example of what is called the 'displacement effect,' which must be taken into account in CBA related to crime prevention.

There are two main mechanisms by which the proposed Policy could, theoretically, reduce the level of criminal activity related to marihuana cultivation in residences:

a) Signal effect: declaration of the activity as illicit may result in some people ceasing their activities; and

b) Deterrence effect: increasing the risk of detection, arrest, seizure and punishment without the legal cover of MMAR production licenses may reduce the marginal return of the illicit activity.

The first effect would appear to be naïve. The second effect is based on rational criminal activity and the altering of the risk/reward trade-off. The economic/rational theory of criminal activity [Becker (1968)] treats crime as a rational activity and postulates that crime prevention/control should also be demonstrated to be rational (and effective).

Crime Prevention Impacts of the Proposed Policy

The proposed Policy will no longer allow (following a phasing-out transition period) the cultivation of marihuana for medical purposes under what are now MMAR production licenses (that mostly involve family residences). This will eliminate the legal ability to cultivate marihuana in a family residence.

As such, it will logically eliminate the threat of violence against families in their residence who cultivate marihuana for medical purposes in their residence. This is not to say that some persons may not continue to do so, but this activity will now be illegal. Therefore, the expected magnitude of this impact depends crucially on the degree to which people desist from future illegal marihuana cultivation in their residence.

Crime Prevention Benefits - Policy

By explicitly developing a model (Policy Transition Model) to look at the rewards and risk of marihuana cultivation misuse (under MMAR in the Status Quo) and the economic returns to crime, this study can more accurately estimate, with the assistance of a behavioural parameter found in the 'economics of crime' literature, the possible impact (net of displacement) on the underlying residential marihuana cultivation. As this CBA has explicitly modelled the continuation of some crime (estimated at 67%) in the Policy scenario, the analysis has appropriately ascribed a reasonable estimate for the benefits arising from crime prevention as a result of the intended Policy impact.

4.13.1 Policy – Security Cost

For each of the security events associated with misuse in the Policy scenario, the social costs associated with residential misuse, home invasions and non-fatal/fatal shootings are given in the Policy scenario over time, by:

$$(120)\quad \text{Security Cost}(t) = \text{Social Loss}_{misuse}(t) + \text{Social Loss}_{invasion}(t) + \text{Social Loss}_{non\text{-}fatal}(t) + \text{Social Loss}_{fatal}(t)$$

as in equation 51.

4.14 Policy – Program Administration Costs

As above for the Status Quo scenario, Health Canada Program Administration Costs are comprised of:

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

4.14.1 Policy – Salary & HR-Related & O&M Costs

Health Canada administrative costs (human resource costs, accommodation, O&M costs) were estimated to be about $1.4 Million in the first year, presumably FY2014-15, for the Policy scenario. These estimates did not include Employee Benefit Program (EBP) costs or HC Corporate functional overhead (which were embedded in the Status Quo MMAP Costs). To ensure consistency between the Status Quo and Policy scenarios, these adjustments were made and base year costs were associated with activity volumes to allow a basis for forecasting changes in HC Program Administration Cost over time as the volume of activity grows.

The assumptions used by Health Canada to underpin the administration cost estimate was that there would be 60 LPs requiring licensing as producers, and that there was a need for two (2) inspections per license, or 120 field inspections. In addition, there were 100 files to be reviewed, although it was unclear how this related to the licenses issued or inspection volume.

HR salary cost, 'grossed-up' by 41% for EBP costs, results in an estimate of $1.89 Million in the first year. About 79% of this cost is HR-Related and 21% is O&M-Related (travel, training, police accompaniment, office supplies, publishing etc). Certain line item costs appeared to be of a fixed nature, so this study estimated that $132,000 (O&M) and $346,675 (HR) were of a fixed nature and the remainder were variable with the volume of activity which is largely related to the number of LP producers.

Based on the assumed number of 60 LPs, these variable cost elements were $4,258 (O&M) per LP and $19,185 (HR) per LP. There were 13.25 FTEs in this base-year estimate.

In the LP Supply Model, the analysis estimated the number of producers that were expected to be in the LP Market, over time, based on a model of LP New Entrants and a scaling growth path over time as they expand along with the overall market scale. Allowance was also made for a Salary Escalation factor (2%) to increase HR costs over time in real terms.

The Health Canada Administration Cost over time, in the Policy scenario is given by:

$$(121)\ \text{HC-Admin Cost}(t) = \{\text{Fixed-HR} + [\text{Variable-HR} * \#\text{LP}(t) * (1 + \text{Salary Escalation})^t]\}$$
$$+ \{\text{Fixed-O\&M} + [\text{Variable-O\&M} * \#\text{LP}(t)]\}$$

This is the counterpart to equation 13 for the Status Quo scenario.

4.14.2 Policy – Corporate Cost

In the Status Quo scenario, there was a fixed component and a variable component of these costs which meant that the Corporate Cost increased at a fixed amount per year.

It was estimated that the HC Corporate Cost represented about 14% of the HC-Administration Cost (FY2013-14), so this ratio was used to benchmark an initial year value of ($1.89 Million * 0.14 = $257,092) for the initial year. Based on the ratio of fixed/total cost in the Status Quo for FY2013-14, it was estimated that about $100,000 is fixed Corporate Cost and about $150,000 is variable Corporate Cost. It was estimated that the step-function increase, per year, would be about $15,000.

The linear equation to predict the future Corporate Cost over time in the Policy scenario is given by:

$$(122)\ \text{Corporate Cost}(t) = 100{,}000 + 15{,}000 * (t)$$

This is the counterpart to equation 12 for the Status Quo scenario. The value for t (FY2014-15) is 10, which is the continuation of the time trend from the Status Quo.

4.14.3 Policy – Program Administration Costs

The sum of Health Canada administrative cost (equation 121) and corporate cost (equation 122) equal the total Program Administration Costs for the Policy scenario:

$$(123)\ \text{Program Administration Cost}(t) = \text{HC-Admin Cost}(t) + \text{Corporate Cost}(t)$$

This is the counterpart to equation 15 for the Status Quo scenario.

4.15 Policy – Summary of Benefits & Costs

Policy – Program Administration Costs

Total HC Program Administration Costs are from equation 123.

Compliance cost is given from equation 111.

Policy – User Benefits

User benefit is the Consumer Surplus measure from equation 114.

Producer Surplus is from equation 115.

The Deadweight Loss (from the HST tax) is given in equation 116.

Policy – Safety Costs

Safety cost is the sum of the Fire Costs from equation 119.

Policy – Security Costs

Security cost is given from equation 120.

4.16 Net Present Value (Policy vs Status Quo)

The Net Present Value is – with the use of a Social Discount Rate (SDR) – the discounted sum over time of the difference between the streams of benefits and costs in the Policy scenario and benefits and costs in the Status Quo scenario.

The Net Present Value is given by:

$$(123)\quad NPV = \sum_t [Policy(t) - Status\ Quo(t)] / [(1+SDR)^t]$$

where

Policy(t)	= the sum of the Policy scenario benefit (if positive) or cost (if negative) estimates for each of the components of the CBA;
Status Quo(t)	= the sum of the Status Quo scenario benefit (if positive) or cost (if negative) estimates for each of the components of the CBA;
SDR	= the Social Discount Rate (8%);
t	= time index from 1 (FY2014-15) to 10 (FY2023-24)

This completes the discussion of the CBA methodology. The report now turns to the CBA Model results.

CHAPTER FIVE

5.0 CBA - Results

This section reports the CBA results from the model described in the previous section on methodology. It presents the CBA results in four sections and provides detailed tables, including the two Accounting Table summaries required by Treasury Board Secretariat.

The CBA results are presented in terms of:

1. Program Usage & Outcomes: resulting from the proposed regulation changes in terms of authorized users and authorized consumption, residential producers, marihuana cultivation misuse and resulting safety and security impacts;

2. Monetized Cost and Benefit Measures: related to users, producers, deadweight loss (from taxes and effective subsidies) and safety and security benefits resulting from lower social costs;

3. Net Present Value Measure: the Discounted Net Present Value (NPV) based on the difference between the Policy scenario and Status Quo scenario streams of costs and benefits over time; and

4. Sensitivity Analysis: the sensitivity of the NPV measure to different reasonable parameter values.

In a CBA, the key measure is the NPV for the Reference Case, supplemented by Sensitivity Analysis of the CBA results based on Monte Carlo analysis of changes to parameter values that underpin the model dynamics (behavioural responses to changes) and monetization of events (in terms of willingness-to-pay measures).

5.1 Program Usage & Outcomes

Tables 5.1 and 5.2 show the forecast results over the 10 year period (FY2014-15 to FY2023-24) for the Reference case for each of the Status Quo and Policy scenarios. These tables show forecast values for:

Program Usage Indicators:

- Authorized marihuana users under the MMAR (Status Quo) and the proposed Policy regime;

- Licensed marihuana producers under the MMAR (DPPL/PUPL) and as LPs;

- KG quantity of marihuana consumed from legal sources of supply; and

- Average supply cost (per KG) from legal sources of supply.

Safety Indicators:

- Number of residential misuse cases for marihuana production (i.e., misuse of PUPL/DPPL production licenses under the MMAR; and persons who are forecast to 'opt out' of the Policy regime and continue home cultivation that is expected to involve supply to the illicit market);

- Number of residential fires predicted to occur as a result of residential misuse marihuana cultivation;

- Number of predicted fire injuries resulting from the residential fires resulting from misuse marihuana cultivation; and

- Number of predicted fire deaths resulting from the residential fires resulting from misuse marihuana cultivation.

Security Indicators:

- Number of potentially violent home invasions that are predicted to arise from residential misuse cases for marihuana production;

- Number of non-fatal shootings that are predicted to arise in relation to home invasions and residential misuse cases for marihuana production; and

- Number of fatal shootings that are predicted to arise in relation to home invasions and residential misuse cases for marihuana production.

A discussion follows (below) on the impact of the Policy in terms of changes between the two cases. The change in outcomes is summarized in Table 5.3 as the difference between the Policy and Status Quo scenarios.

TABLE 5.1 - STATUS QUO – PROGRAM OUTCOMES & INDICATORS										
	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24
Usage Indicators										
Authorized Marihuana Users	57,799	93,338	141,461	201,426	267,769	330,345	378,943	409,706	426,025	433,688
Licensed Marihuana Producers	38,532	62,226	94,308	134,284	178,512	220,230	252,629	273,138	284,017	289,126
Marihuana KG Consumed	67,573	107,841	163,853	233,748	312,556	388,859	450,964	493,027	517,204	529,672
Value of Consumption ($M)	$156	$248	$373	$526	$702	$869	$1,001	$1,090	$1,143	$1,176
Supply Value Per KG	$2,310	$2,300	$2,277	$2,251	$2,247	$2,235	$2,220	$2,211	$2,211	$2,221
Safety Indicators										
Residential Misuse	15,259	24,641	37,346	53,177	70,691	87,212	100,041	108,163	112,470	114,494
Fires	96	158	237	340	451	557	638	689	718	730
Fire-Injuries	5	7	10	15	20	26	29	31	32	32
Fire-Deaths	0	0	1	1	1	1	1	2	2	2
Security Indicators										
Home Invasions	53	86	130	186	247	305	349	378	393	400
Non-Fatal Shootings	6	9	14	20	26	32	37	40	42	43
Fatal Shootings	1	2	2	3	5	6	7	7	7	8

TABLE 5.2 - POLICY – PROGRAM OUTCOMES & INDICATORS										
	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24
Usage Indicators										
Registered Marihuana Users	41,384	66,435	100,814	143,138	189,486	233,131	267,559	290,134	302,652	308,755
Licensed Marihuana Producers	51	51	51	51	61	61	61	61	61	61
Marihuana KG Consumed	26,734	41,681	61,462	84,809	109,458	132,216	150,204	162,203	168,992	172,450
Value of Consumption ($M)	$179	$284	$427	$604	$800	$989	$1,143	$1,249	$1,310	$1,341
Supply Value Per KG	$6,698	$6,808	$6,955	$7,128	$7,310	$7,478	$7,612	$7,700	$7,751	$7,776
Safety Indicators										
Residential Misuse	11,102	17,276	25,248	34,539	43,957	51,976	57,598	60,873	62,518	63,269
Fires	66	104	152	207	264	312	345	365	375	380
Fire-Injuries	3	5	7	9	12	14	15	16	17	17
Fire-Deaths	0	0	0	1	1	1	1	1	1	1
Security Indicators										
Home Invasions	43	66	97	133	169	200	221	234	240	243
Non-Fatal Shootings	4	7	10	14	18	21	24	25	26	26
Fatal Shootings	1	1	2	3	3	4	4	4	5	5

TABLE 5.3 – CHANGE/POLICY IMPACT – PROGRAM OUTCOMES & INDICATORS										
	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24
Usage Indicators										
Registered Marihuana Users	-16,415	-26,903	-40,647	-58,288	-78,283	-97,214	-111,384	-119,572	-123,373	-124,933
Licensed Marihuana Producers	-38,481	-62,175	-94,257	-134,233	-178,451	-220,169	-252,568	-273,077	-283,956	-289,065
Marihuana KG Consumed	-40,838	-66,160	-102,392	-148,939	-203,098	-256,643	-300,760	-330,824	-348,212	-357,221
Value of Consumption ($M)	$23	$36	$54	$78	$98	$120	$142	$159	$167	$165
Supply Value Per KG	$4,387	$4,509	$4,678	$4,877	$5,063	$5,243	$5,391	$5,490	$5,540	$5,555
Safety Indicators										
Residential Misuse	-4,157	-7,365	-12,098	-18,638	-26,734	-35,236	-42,443	-47,290	-49,952	-51,225
Fires	-30	-54	-85	-133	-187	-245	-293	-324	-343	-350
Fire-Injuries	-2	-2	-3	-6	-8	-12	-14	-15	-15	-15
Fire-Deaths	0	0	-1	0	0	0	0	-1	-1	-1
Security Indicators										
Home Invasions	-10	-20	-33	-53	-78	-105	-128	-144	-153	-157
Non-Fatal Shootings	-2	-2	-4	-6	-8	-11	-13	-15	-16	-17
Fatal Shootings	0	-1	0	0	-2	-2	-3	-3	-2	-3

Authorized Users of Marihuana for Medical Purposes

The number of authorized users of marihuana for medical purposes decreases by about 30% over the period as a result of potential users: a) 'opting out' to undertake illegal residential marihuana cultivation; and b) being 'priced out' of the market through higher prices and the operation of the price elasticity of demand. This is shown in Figure 5.1.

Consumption of Marihuana from Legal Sources

The quantity of marihuana consumption from legal sources decreases by over 65% as a result of the reduction in the number of users and the quantity consumed per user. The latter effect results from the higher price, the operation of price elasticity of demand, and an affordability effect that spending on marihuana from legal sources does not exceed more than 15% of the mean annual income of users. This is shown in Figure 5.2.

Figures 5.1 & 5.2 – Program Usage Indicators

Figure 5.1 Legal Users

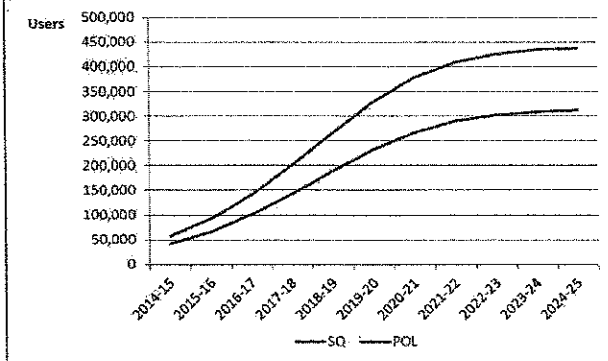
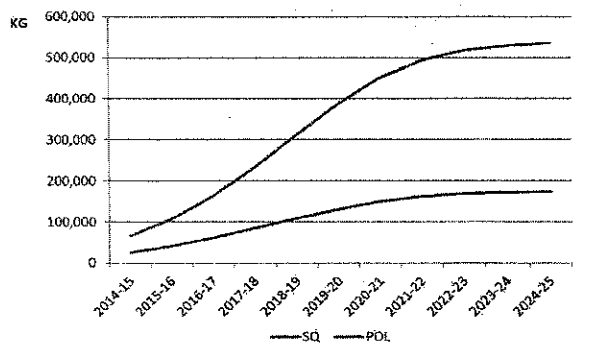


Figure 5.2 Legal Consumption KG



Source: Delsys Research

Value of Marihuana Consumed by Authorized Users

The value of marihuana consumed by authorized users increases by almost 15% as a result of the interplay between lower marihuana consumption and higher marihuana supply price. This value is the product of the quantity of authorized marihuana consumption (KG) times the supply price of the marihuana obtained from a legal source consumed. This is shown in Figure 5.3. The Policy change to create a regulated marihuana supply market comprised of Licensed Producers could, over time, grow to be a $1.3 Billion per year industry.

Price of Marihuana Produced by LPs

The average supply price for marihuana produced by licensed producers increases by about 250% over time as a result of the elimination of low-cost legal own-cultivation (and designated person production) and the transition to LP supply with security, quality control and other regulatory requirements. This is shown in Figure 5.4.

Figures 5.3 & 5.4 – Program Usage Indicators

Figure 5.3 Legal Value $M

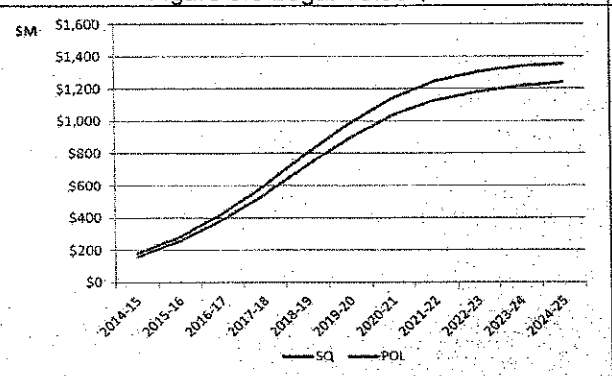
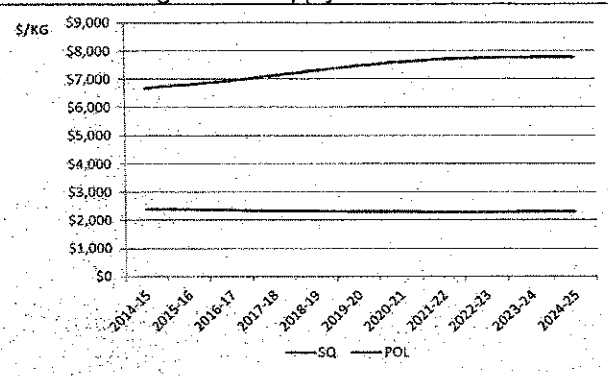


Figure 5.4 Supply Price $/KG



Source: Delsys Research

Safety Indicators

The number of cases of potential misuse in terms of residential marihuana cultivation for the purpose of supplying the illicit market decreases by 45% over the forecast period as a result of: a) more effective law enforcement activity through the elimination of MMAR production licenses by removing the need to obtain additional evidence (above that normally required to obtain reasonable and probable grounds to investigate potential misuse); and b) a deterrent effect as the probability of conviction increases.

The number of residential fires caused by faulty/misused electrical devices and systems that arise from indoor marihuana cultivation decreases by almost 50%. This is shown in Figure 5.5.

The number of fire-related injuries is reduced by a similar percentage – close to 50%. There is a cumulative reduction of 92 injuries over the forecast period. This is shown in Figure 5.6.

There are four (4) fire-related deaths averted over the forecast period as a result of the policy to eliminate legal residential marihuana cultivation.

Figures 5.5 & 5.6 – Safety Indicators

Figure 5.5 Fires Related to Misuse

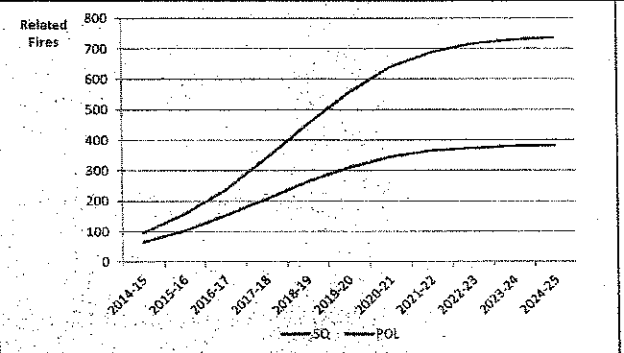
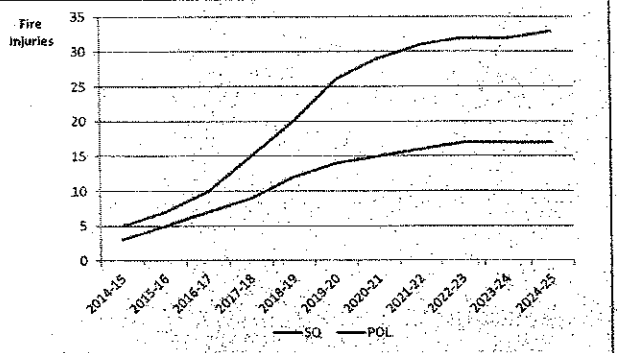


Figure 5.6 Fire-Related Injuries



Source: Delsys Research

Security Indicators

The number of potentially violent home invasions that arise because of misuse in terms of residential marihuana cultivation for the purpose of supplying the illicit market decreases by 40% over the forecast period as a result of: a) more effective law enforcement activity due to the increased clarity as a result of the elimination of MMAR production licenses; and b) a deterrent effect as the probability of conviction increases. This is shown in Figure 5.7.

The number of cases of home invasions with non-fatal shootings decreases by over 40%. There is a cumulative reduction of 94 non-fatal shootings over the forecast period. This is shown in Figure 5.8.

There is a cumulative reduction of 16 fatal shootings over the forecast period.

Figures 5.7 & 5.8 – Security Indicators

Figure 5.7 Home Invasion Related to Misuse

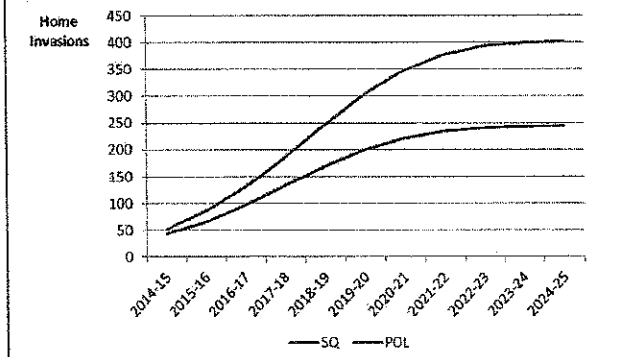
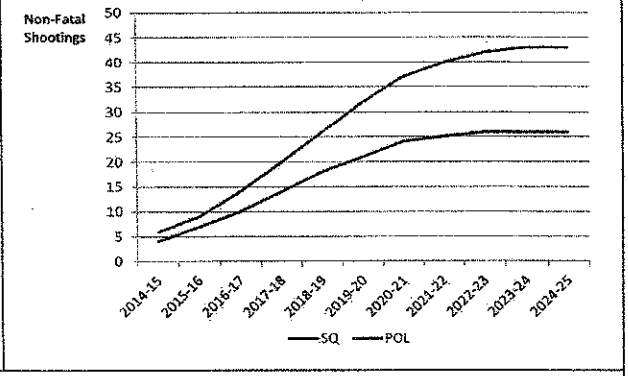


Figure 5.8 Non-Fatal Shootings



Source: Delsys Research

5.2 Monetized Cost & Benefits Measures

Tables 5.4 and 5.5 show the forecast results over the 10-year period (FY2014-15 to FY2023-24) for the Reference case for each of the Status Quo and Policy scenarios. These tables show forecast values for monetized Costs and Benefits including:

1. Consumer Surplus: a measure of user benefit;
2. Producer Surplus: a measure of supplier benefit;
3. Deadweight Loss: a measure of economic loss resulting from tax/subsidy distortions from the market equilibrium most efficient use of resources;
4. Program Administration Costs: Health Canada program administration costs to oversee the Marihuana Medical Access Program;
5. Safety Costs: a measure of the economic loss associated with fires resulting from residential marihuana cultivation;
6. Security Costs: a measure of the economic loss associated with home invasion and shootings resulting from the misuse of residential marihuana cultivation; and
7. Business Compliance Costs: a measure of the incremental costs that business must bear as a result of regulatory requirements that are beyond normal business practice[30].

For the purposes of these Tables, CBA costs are those variables with negative values (implying a social cost) and CBA benefits are those variables with positive values (implying a social benefit).

A discussion follows of the impact of the proposed Policy in terms of changes between the two cases. The change in outcomes is summarized in Table 5.6 as the difference between the Policy and Status Quo scenarios. These are the values that are discounted, using a Social Discount Rate of 8% in the Reference case, to produce the estimate of the Net Present Value (NPV).

[30] Business Compliance Costs are shown in the CBA as they form a part of the RIAS analysis. As Business Compliance Costs are already included in the cost of supply, these are not additional in terms of the CBA result.

TABLE 5.4 – STATUS QUO – MONETIZED CBA RESULTS

	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24
CBA - Costs (Negative)										
HC - Program Administration	-20,630,103	-30,008,114	-42,160,070	-56,881,976	-73,004,828	-88,422,448	-101,019,733	-109,963,905	-115,917,275	-120,064,397
Deadweight Loss	-1,971,263	-3,171,138	-4,626,278	-6,830,658	-7,820,031	-9,236,870	-9,893,372	-10,202,535	-10,731,985	-11,764,122
Safety - Social Cost	-3,705,188	-6,081,774	-14,916,011	-18,886,520	-23,160,253	-27,257,771	-30,367,814	-38,127,467	-39,239,954	-39,694,790
Security - Social Cost	-8,864,700	-17,047,400	-18,439,000	-27,375,400	-43,621,300	-52,605,500	-61,187,100	-62,084,200	-62,578,700	-70,004,000
Sub-Total CBA Costs	-35,171,254	-56,308,426	-80,041,359	108,974,554	-147,606,412	-177,522,589	-202,468,019	-220,378,107	-228,467,913	-241,527,309
CBA - Benefits (Positive)										
User - Consumer Surplus	278,021,823	443,096,890	672,631,011	959,070,572	1,281,745,711	1,594,297,577	1,848,899,513	2,021,398,354	2,120,374,124	2,171,027,371
Producer Surplus	0	0	0	0	0	0	0	0	0	0
Sub-Total CBA Benefits	278,021,823	443,096,890	672,631,011	959,070,572	1,281,745,711	1,594,297,577	1,848,899,513	2,021,398,354	2,120,374,124	2,171,027,371
Other (Non-CBA) Costs										
Business Compliance	-2,354,664	-3,584,649	-4,927,424	-6,193,331	-8,095,245	-9,437,517	-10,057,428	-10,349,048	-10,848,100	-11,820,110

TABLE 5.5 – POLICY – MONETIZED CBA RESULTS

	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24
CBA - Costs (Negative)										
HC - Program Administration	-1,924,268	-1,965,770	-2,007,272	-2,048,775	-2,340,055	-2,385,394	-2,430,733	-2,476,072	-2,521,412	-2,566,751
Deadweight Loss	-464,119	-748,188	-1,152,209	-1,671,596	-2,271,736	-2,874,843	-3,385,975	-3,744,253	-3,953,242	-4,061,440
Safety - Social Cost	-2,541,498	-4,008,412	-5,854,356	-13,765,621	-15,965,992	-17,811,936	-19,076,035	-19,847,395	-20,239,725	-20,429,240
Security - Social Cost	-8,489,700	-9,243,400	-17,378,300	-25,700,700	-26,833,100	-34,968,000	-35,673,900	-36,052,600	-43,454,000	-43,525,700
Sub-Total CBA Costs	-13,419,585	-15,965,771	-26,392,137	-43,186,691	-47,410,883	-58,040,173	-60,566,643	-62,120,320	-70,168,379	-70,583,131
CBA - Benefits (Positive)										
User - Consumer Surplus	289,235,420	448,337,593	656,021,931	896,947,174	1,146,355,466	1,372,117,274	1,547,502,175	1,662,984,297	1,727,796,665	1,760,658,419
Producer Surplus	2,644,475	6,428,038	13,976,839	26,612,531	44,329,865	64,679,652	89,476,731	97,346,190	105,666,227	110,034,860
Sub-Total CBA Benefits	291,879,895	454,765,631	669,998,770	923,559,704	1,190,685,331	1,436,796,926	1,630,978,906	1,760,330,487	1,833,462,891	1,870,693,279
Other (Non-CBA) Costs										
Business Compliance	-20,126,430	-21,907,819	-24,265,316	-27,047,930	-33,307,251	-36,019,576	-38,163,485	-39,593,530	-40,402,723	-40,814,858

TABLE 5.6 – CHANGE/POLICY IMPACT – MONETIZED CBA RESULTS										
	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24
CBA - Costs (Negative)										
HC - Program Administration	18,705,835	28,042,344	40,152,798	54,833,201	70,664,773	86,037,054	98,589,000	107,487,832	113,395,863	117,497,646
Deadweight Loss	1,507,145	2,422,949	3,374,069	4,159,063	5,548,296	6,362,027	6,507,397	6,458,282	6,778,743	7,702,681
Safety - Social Cost	1,163,690	2,073,362	9,061,655	5,120,899	7,194,261	9,445,835	11,291,779	18,280,072	19,000,229	19,265,550
Security - Social Cost	375,000	7,804,000	1,060,700	1,674,700	16,788,200	17,637,500	25,513,200	26,031,600	19,124,700	26,478,300
Sub-Total CBA Costs	21,751,670	40,342,656	53,649,222	65,787,863	100,195,529	119,482,416	141,901,375	158,257,786	158,299,535	170,944,178
CBA - Benefits (Positive)										
User - Consumer Surplus	11,213,597	5,240,702	-16,609,079	-62,123,399	-135,390,245	-222,180,303	-301,397,337	-358,414,057	-392,577,459	-410,368,952
Producer Surplus	2,644,475	6,428,038	13,976,839	26,612,531	44,329,865	64,679,652	83,476,731	97,346,190	105,666,227	110,034,860
Sub-Total CBA Benefits	13,858,072	11,668,741	-2,632,240	-35,510,868	-91,060,380	-157,500,652	-217,920,606	-261,067,867	-286,911,232	-300,334,092
Total CBA Net Benefits	35,609,742	52,011,396	51,016,982	30,276,995	9,135,149	-38,018,236	-76,019,231	-102,810,081	-128,611,698	-129,389,915
Other (Non-CBA) Costs										
Business Compliance	-17,771,766	-18,323,170	-19,337,892	-20,854,599	-25,212,005	-26,582,059	-28,106,057	-29,244,482	-29,554,624	-28,994,747

5.2.1 Consumer Surplus Measure of User Benefit

Consumer Surplus is a measure of user benefit over and above what is reflected in the user price paid for acquiring the good (i.e., marihuana for medical purposes produced by an authorized LP). It reflects the willingness-to-pay by users and is captured as the area under the Demand curve and above the price either paid by consumers or reflecting the supply cost of producing the good.

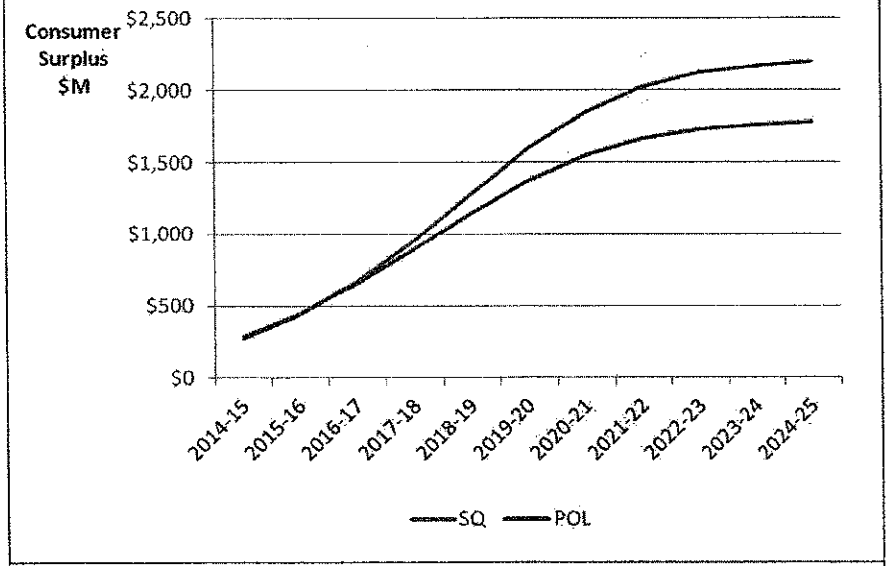
As is shown in Table 5.3 and Figures 5.1, 5.2 and 5.4, the Policy scenario projects a reduction in the number of individuals accessing marihuana under the MMAP, and KG consumed, and an increase in the user price of marihuana consumed. These changes indicate that there would be a loss of Consumer Surplus under the Policy scenario.

The valuation of Consumer Surplus depends on the Slope and Intercept of the Demand curve, which was inferred from a single assumption related to the Price Elasticity of Demand for a linear Demand curve. For the Status Quo scenario, separate measures were taken for each of the distinct 'supply markets' pertaining to Government Supply, Personal-Use supply and Designated-Person supply options. These were then summed to give an overall Consumer Surplus.

The Policy scenario has a single legal LP Market for supply and similar reasoning can be applied for the Price Elasticity of Demand and a linear Demand curve to estimate Consumer Surplus.

The Consumer Surplus decreases in the Policy scenario by almost 20% over the forecast period. This is shown in Figure 5.9. That Consumer Surplus decreases by about 20% when the marihuana KG consumed for medical purposes under the MMAP decreases by 65% requires some explanation.

Figure 5.9 Consumer Surplus – Measure of User Benefit



Source: Delsys Research

The estimation of Consumer Surplus is influenced by the willingness-to-pay valuation of consumers as reflected in the Demand curve and determined (in part) by the Demand Intercept, which captures the marginal willingness-to-pay for the first user in the market. With linear Demand and this study's estimation of the Demand Intercept based on the Price Elasticity of Demand, the Demand Intercept is much higher when the known (observed) transacted market price is higher.

The Policy scenario involves market transactions in the range of $7.60 to $8.80 per gram over time, reflecting the higher cost of marihuana from the LP market. The higher cost also reflects higher product quality in terms of multiple strains of cannabis and production quality control to limit contaminants and toxic substances and ensure a consistently high quality of product over time. In the Reference case, the Demand Intercept in the LP market is equivalent to $29.20 per gram.

The Status Quo scenario involves three separate supply markets, each with their own supply price. The Demand intercepts for these separate markets are: $25.00 per gram (Government Supply), $14.00 per gram (Designated Person) and $9.00 per gram (Personal Use).

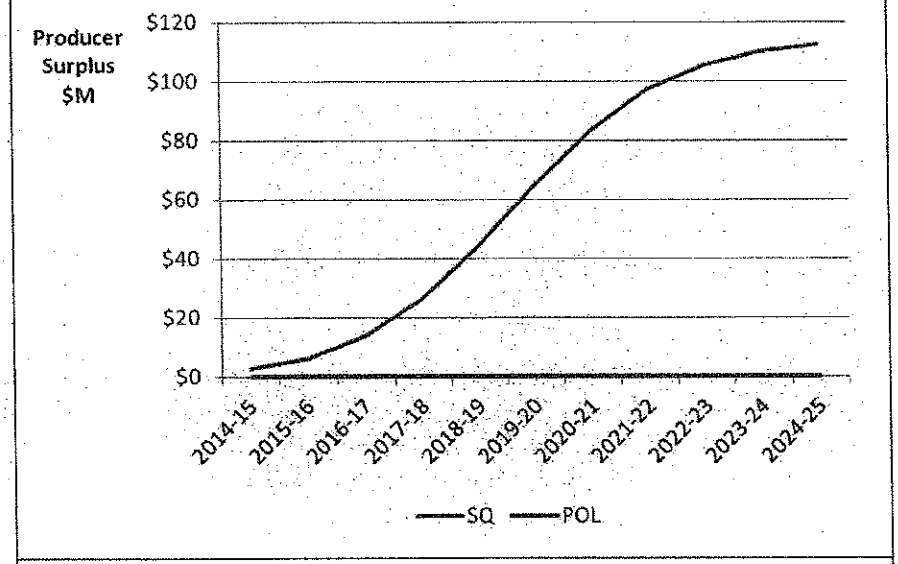
Therefore, the Consumer Surplus measure in the Policy scenario is much higher (for a given level of marihuana consumption) than in the Status Quo scenario. This is a direct result of the mathematical logic of the study's model and is generally reflective of higher product quality and costs associated with marihuana cultivation by LPs operating under rigorous quality control standards.

5.2.2 Producer Surplus Measure of Supplier Benefit

Producer Surplus is a measure of supplier benefit over and above what is reflected in the user price paid for acquiring the good (i.e. marihuana for medical purposes produced by an authorized LP). It reflects lower marginal cost for units below the equilibrium quantity. There was no Producer Surplus in the Status Quo scenario as the social valuation of the marihuana produced in the Government Supply was below the supply (and marginal cost) of production as a result of the effective subsidy to production. There also was no Producer Surplus in the Personal-Use or Designated-Person supply markets as these have perfectly elastic (i.e., flat) Supply curves.

There was Producer Surplus in the Policy scenario as the LP Supply curve is upward sloping. The value of Producer Surplus, however, was quite small in comparison with Consumer Surplus, as can be seen in Figure 5.10 (when compared to the scale in Figure 5.9). This result was attributable to the relatively inelastic (i.e., relatively flat) Supply curve in the Policy scenario.

Figure 5.10 Producer Surplus – Measure of Supplier Benefit



Source: Delsys Research

Consumer and Producer Surplus are the two measures of social benefit in the CBA. The analysis of the Policy scenario involves a projected reduction in Consumer Surplus and an increase in Producer Surplus. However, because the former overshadows the latter, the overall result is a projected reduction in social benefit, which contributed negatively to the NPV overall result.

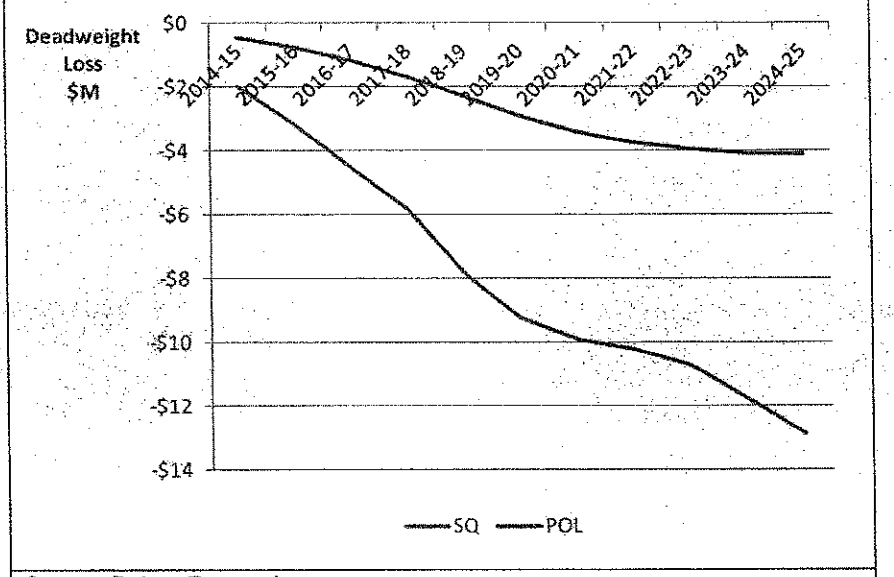
5.2.3 Deadweight Loss from Market Distortion (Tax/Subsidy)

Deadweight Loss arises in the Status Quo scenario from the effective subsidy to production that results in excess demand relative to the market equilibrium without such subsidy. The value of this loss is relatively small as the Government Supply component in the CBA model was comparatively small.

Deadweight Loss arises in the Policy scenario from the projected application of HST tax on marihuana which creates a 'tax wedge' between the price users would pay and the supply price that would be received by suppliers. The value of this loss is also relatively small.

The estimated Deadweight Loss in both cases, as shown in Figure 5.11, plays no significant role in the overall CBA results and findings. The analysis projects a small Deadweight Loss as a result of the Policy change. The loss is shown as a negative value compared to the benefit measures related to Consumer and Producer Surplus.

Figure 5.11 Deadweight Loss – Economic Cost of Tax/Subsidy



Source: Delsys Research

As the Policy scenario involves a lesser loss (i.e., smaller negative value), this outcome constitutes a reduction in social cost which contributes positively to the NPV overall result.

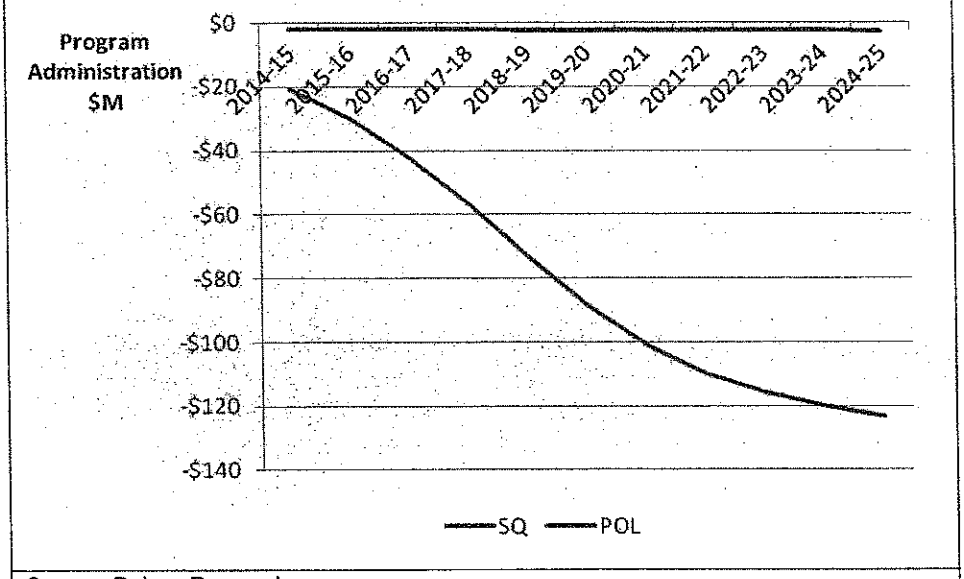
5.2.4 Health Canada - Program Administration Costs

In both the Status Quo and Policy scenarios, Health Canada is responsible for Program Administration in terms of employee salaries, benefits and accommodation as well as travel and supply (e.g., specialized equipment) costs associated with inspections and office work. These are costs and are represented as negative values in the analysis.

The 'contract value' associated with the Government Supply in the Policy scenario is not included in this section, as it forms part of the cost of supply that was taken into account in the estimation of Consumer and Producer Surplus measures.

As Health Canada will eliminate the role it plays in determining eligibility of persons to access the legal supply of marihuana for medical purposes, the Program Administration cost is lower in the Policy scenario than in the Status Quo scenario. This is shown in Figure 5.12.

Figure 5.12 HC Program Administrative Cost



Source: Delsys Research

The Policy scenario reduction of over 95% of Program Administration costs is a relatively modest source of savings (and benefits) in the context of the overall NPV result.

This graphic highlights an important point about the Status Quo scenario. The Status Quo scenario is modeled on the assumption that government resources required to administer the MMAP will 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 is projected to increase from $13.8M (FY2013-14) to over $120M (FY2023-24). In reality, the Government of Canada is, and will likely continue to be for some time, operating under a fiscal restraint. It is, therefore, highly unlikely that such additional resources would be available (over time) to fully accommodate the forecast increase in the MMAP participation in the status quo.

Consequently, achievement of the Status Quo scenario benefits, in terms of increasing Consumer Surplus, is at considerable risk of not being realized. Rather than impose a specific government resource constraint on the Status Quo, the analysis of the Status Quo scenario adopted an assumption of continued ATP growth and growing Health Canada 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 interpreting the overall NPV result. This analysis 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 would be made available to scale program delivery capacity in response to service demands growing at an exponential rate up to some limit – even though there is substantial risk that this would not be realized in reality.

Figure 5.12 shows the large resource 'gap' (the difference between the Status Quo and Policy scenarios) which represents the Health Canada savings that would be required to respect overall departmental and Government of Canada fiscal restraint objectives.

The impact of a resource constraint was analyzed (Figure 4.5 above) using a System Dynamics simulation model. The simulation results indicated that the number of ATPs in a constrained Status Quo scenario might be only about 1/3rd of the unconstrained case (i.e. perhaps only 150,000 ATPs could be accommodated in the program over the forecast period in the constrained Reference case compared to the ceiling value of 450,000 in the unconstrained Reference case). The practical implication of a resource constraint is that there would be substantial backlogs and lengthy time delays for processing new applications and renewals of ATPs.

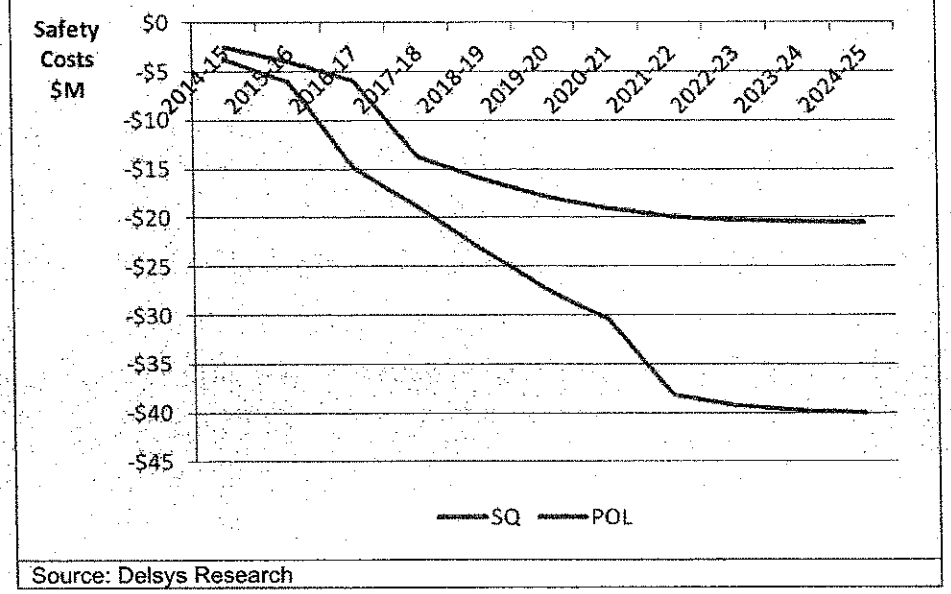
5.2.5 Monetized Safety Costs

Monetized Safety Costs relate to residential fire events and the estimated property damage and willingness to pay to avoid fire-related injuries and deaths. Canadian data for fires specific to electrical causes have been used to estimate fire risks and outcomes in terms of damage, injury and deaths. The property damage estimate (from insurance claims) provides a direct estimate for that cost. The values for willingness to pay to avoid injury and death has been were derived from other Canadian and international studies.

It is known (Table 5.11 and Figure 5.5) that the Policy scenario involves a reduction in the number of residential cases of misuse and fire events related to marihuana cultivation and residential misuse. It would therefore be expected that the Safety Costs would decrease in the Policy scenario. As costs are treated in the CBA analysis as negative values, the reduction in negative values is a positive benefit.

The Policy scenario involves a decrease in Safety Costs of almost 50% over the forecast period. This is shown in Figure 5.13. The scale of the Safety Costs is small in relation to the Consumer Surplus change so these represent a modest source of savings (and benefits).

Figure 5.13 Safety Costs



Source: Delsys Research

The step-function nature of the curves in the above figure is a result of the large monetary value attributable to fire deaths which change in a discontinuous manner as the number of fire deaths is restricted to integer values.

The reduction of adverse safety and security outcomes is, perhaps, the most important aspect of the Health Canada proposed changes to the regulatory regime. Figure 5.13 (safety) and Figure 5.14 (security) demonstrate that the model of behavioural response and valuation of outcomes resulting from the Policy change achieve a substantial reduction in the social costs arising from adverse public safety and public security outcomes.

5.2.6 **Monetized Security Costs**

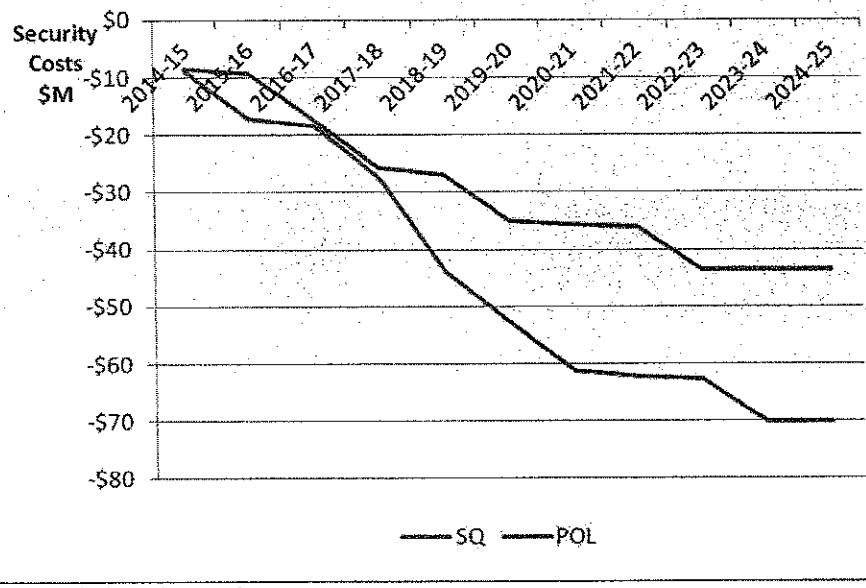
Monetized Security Costs relate to violent home invasions and shootings (non-fatal and fatal) that arise from criminal attempts to seize the asset value associated with marihuana cultivation and misuse. Law enforcement authorities refer to such crime, directed at 'grow-op' type operations, as 'grow-rip' robberies. The presence of handguns by perpetrators of home invasions, as well as possibly handgun possession by persons engaged in marihuana cultivation misuse, can (and have, in the past) led to shootings.

Canadian data on home invasions and shooting related to marihuana cultivation under the MMAR are available and have been used to estimate security risks and outcomes in terms of home invasions, shootings and deaths. Willingness to pay to avoid home invasion, non-fatal shooting and fatal shootings have been adapted from US and UK social-cost data specific to comparable types of crime.

It is known (Table 5.11 and Figure 5.7) that the Policy scenario involves a reduction in the number of residential cases of misuse. Security Costs are therefore expected to decrease in the Policy scenario. As costs are treated in the CBA as negative values, the reduction in negative values is a positive benefit.

The Policy scenario involves a decrease in Security Costs by roughly 40% over the forecast period. This is shown in Figure 5.14. The scale of the Security Costs is small in relation to the Consumer Surplus change, so these represent a modest source of savings (and benefits).

Figure 5.14 Security Costs



Source: Delsys Research

Security Costs are estimated to be about twice the scale of Safety Costs and contribute proportionally the same to the NPV benefit gain of the Policy scenario over time.

The Deadweight Loss, Program Administration Costs, Safety Costs and Security Costs are the four measures of social cost in the CBA. As the Policy scenario involves a reduction in all these costs the overall result is a reduction in social cost, which contributes positively to the NPV overall result.

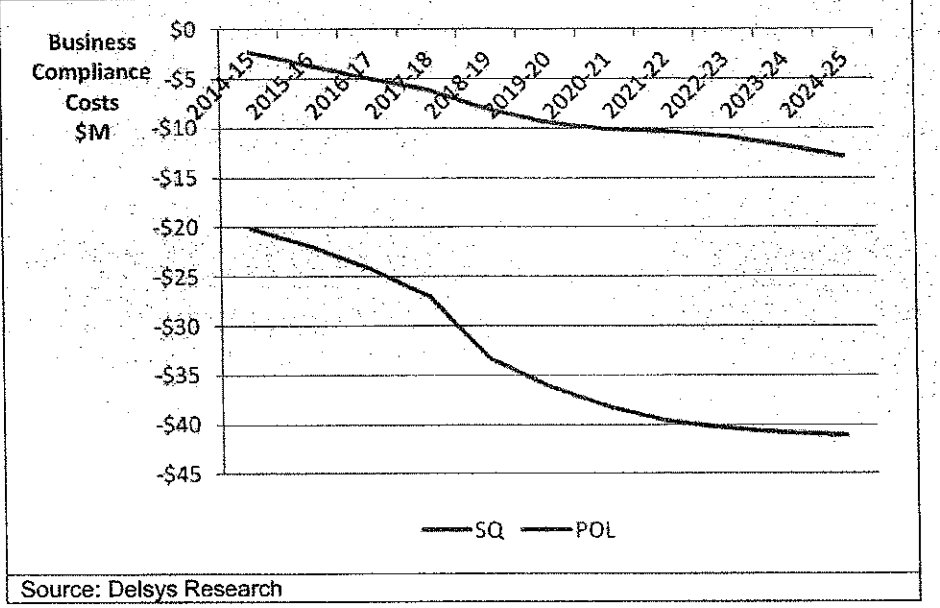
5.2.7 Business Compliance Costs

Business Compliance Costs are estimated in both the Status Quo and Policy scenarios. The assumption used in the Status Quo scenario is that a fixed share of overall Supply Cost (10%) is comprised of Business Compliance Costs. This is a fairly high value as a result of the nature of the contractual relationship between Health Canada and the contracted Government Supplier. It is generally perceived by Health Canada that the regulatory burden faced by LPs in the Policy scenario will be considerably less per unit of production (i.e., reduced red tape per supplier).

However, Government Supply represents a small share (about 10% in terms of people, about 3% in terms of KG consumed) of marihuana supply in the Status Quo scenario, whereas Licensed Producers will account for all (100%) of the marihuana supply in the Policy scenario. Therefore, while the regulatory compliance burden per unit of activity will be substantially less, it will apply to a much larger volume of activity. Business Compliance Costs are anticipated to fall from 10% of revenue in the Status Quo scenario to about 3% of revenue in the Policy scenario (by FY2020-21).

The overall result, as shown in Figure 5.15, is that the Business Compliance Costs will be about two to three times greater in the Policy scenario.

Figure 5.15 Business Compliance Costs



Source: Delsys Research

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 result and are used, instead, in the RIAS and other TBS regulatory assessment processes[31].

The Business Compliance Costs mostly fall on Medium and Large Business (as opposed to Small Business) as the scale of LP activity (in terms of employees and sales revenue) is expected to grow beyond that of a Small Business after two years.

[31] TBS 'One for One' and 'Small Business Lens' requirements.

5.3 Net Present Value

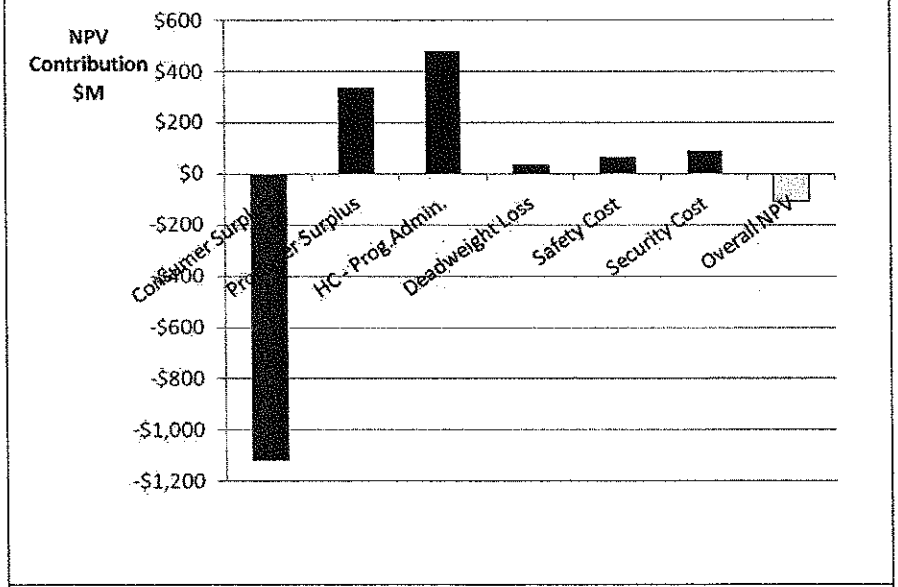
The main focus of the CBA results is on the Reference case (i.e., most likely) estimate of the Net Present Value. This sums the various cost and benefit measure differences between the Policy and Status Quo scenarios, over time, after discounting by a social discount rate that values future year results as less valuable than more current year results. The purpose of social discounting is to reflect the social opportunity cost of resources which are values higher the closer they are in time to the present period.

5.3.1 Reference Case

The Reference case NPV is -$109.72 Million, with an annualized NPV of -$16.35 Million. This result is shown in Table 1 of the CBA Accounting Statement (as per TBS guidelines).

As discussed in the previous section, the bulk of the NPV result arises from the loss of Consumer Surplus resulting from reduced consumption and a higher supply price for persons consuming marihuana for medical purposes under the MMAP. Figure 5.16 shows the contribution to the overall NPV result from each of the CBA cost and benefit components. In terms of the offsetting positive contributions the largest contributors are the reduction in Health Canada Program Administration costs and the Producer Surplus. While the contribution to the NPV result from reduced safety and security costs is small in comparison to the overall NPV result, these are still large in absolute value.

Figure 5.16 Composition of Reference Scenario NPV
By Benefit-Cost Component



Source: Delsys Research

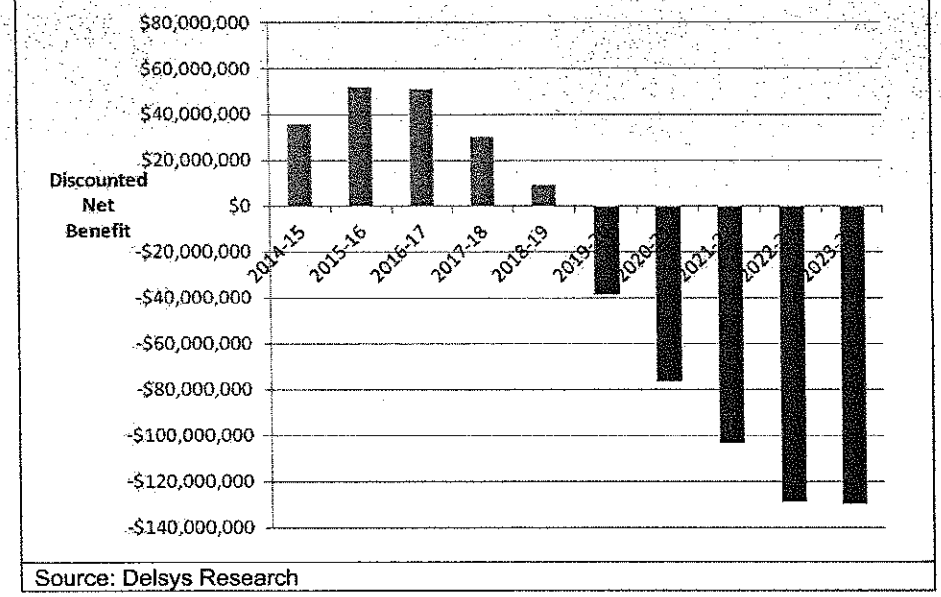
The relative magnitude of the net benefit contributions to the overall NPV result can also be seen, in undiscounted flows by year, in Table 5.6.

5.3.2 Time Profile of Discounted Net Benefits

The Reference case NPV of -$109.72 Million results from the sum of a discounted stream of net benefits (i.e., benefits less costs) for each year. This is shown in Figure 5.17.

The net benefits start off positive for the first five years (i.e., discounted benefits exceed discounted costs), then turn sharply negative for the remaining five years of the time horizon. The sum of positive discounted net benefits for the first five years (+$158 Million) is more than offset by the sum of negative discounted net benefits for the last five years (-$268 Million), which generates the negative NPV result in the Reference case.

Figure 5.17 Time Profile of Contribution to NPV Result



Source: Delsys Research

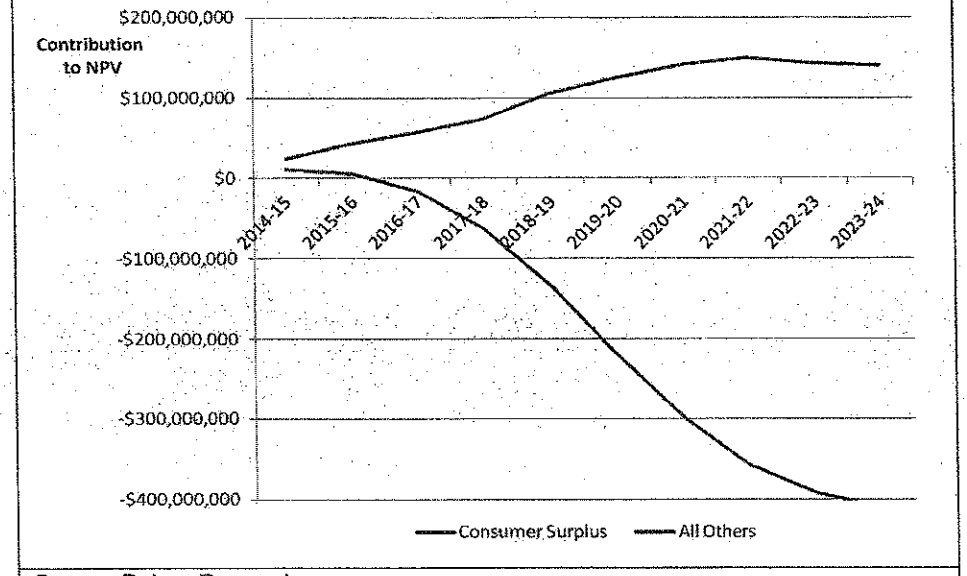
In the first five years, with positive discounted net benefits, there are a number of circumstances that produce greater benefits (with positive discounted net benefit) than costs (with negative discounted net benefit):

a) The change in Consumer Surplus (Policy scenario minus Status Quo scenario) starts off as positive and becomes negative by year 3 – up until that point, all components of NPV are positive; and

b) With the Consumer Surplus contribution negative in year 3, it is not sufficiently negative for another three years (until year 6), at which time the negative value for the change in Consumer Surplus fully offsets the other positive components of NPV.

This can be seen in Figure 5.18, which shows the time paths for Consumer Surplus (in red) and for the sum of 'Other' components (in blue). Consumer Surplus grows more rapidly (i.e., negatively) than the Other components grow (positively). It is between the fifth and sixth years that the vertical distance between the blue line and the x-axis is the same as the vertical distance between the red line and the x-axis. This is where the contribution to NPV becomes zero and the negative contribution to NPV from Consumer Surplus is exactly offset by the positive contribution to NPV from Other components.

Figure 5.18 Time Profile of Consumer Surplus and Other Components: Contribution to NPV Result



Source: Delsys Research

Rationale for Positive Initial Consumer Surplus Contribution

This study now turns to the rationale for the change in Consumer Surplus starting off positive for the first two years of the time horizon. The change in Consumer Surplus is broken down as a function of: a) lower KG-Demand moving towards the higher priced Policy scenario; and b) a higher valuation of Consumer Surplus in the higher priced Policy scenario (as seen in Figure 5.19):

A. Less KG-Demand: If this is valued at the Consumer Surplus value (per KG) in the Status Quo scenario, the impact of reducing KG-Demand in the Policy scenario is negative (in terms of contribution to NPV) – as seen in the blue data points – and its slope, in terms of KG-Demand, is -$2,668/KG; and

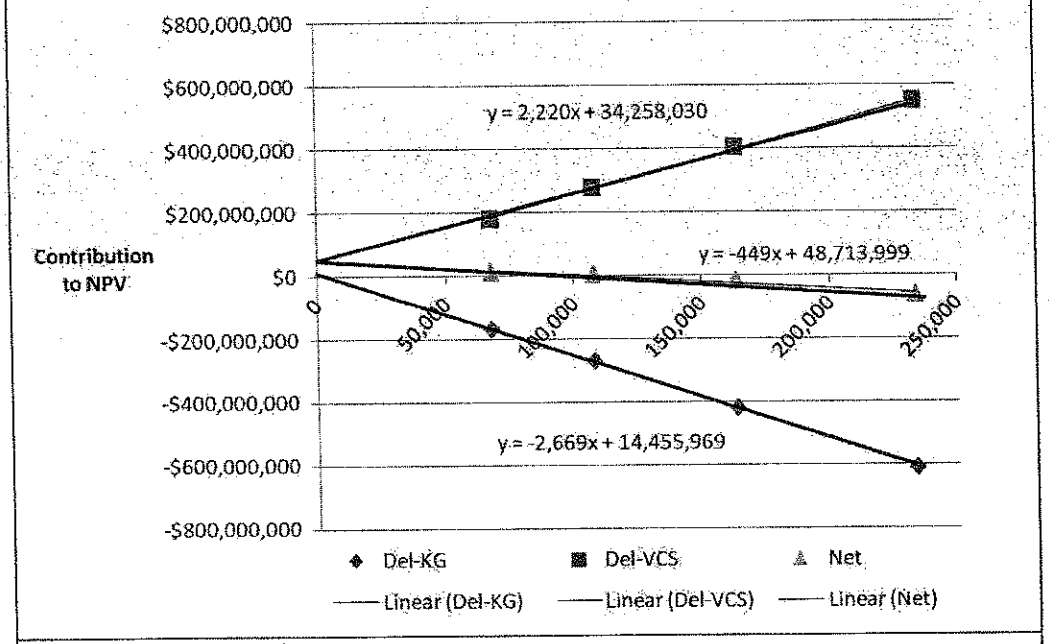
B. Greater CS-Value per KG: In the Policy scenario, each KG-Demand adds to Consumer Surplus at a higher value (per KG) – roughly $10,500/KG – than each KG-Demand in the Status Quo scenario – roughly $4,100/KG. This is a consequence of the higher exchange value (i.e., price) and the higher price intercept for the Demand curve. When this contribution is valued at the KG-Demand in the Policy scenario, its contribution is positive (in terms of NPV) – as seen in the red data points – and its slope, in terms of KG-Demand, is $2,220/KG.

As the combined effect (i.e., slope) is the sum of these separate effects (i.e., slopes), the overall slope of the relationship (i.e., the marginal effect on Consumer Surplus per KG-Demand) is negative ($2,220 + - $2,668 = -$449).

However, the intercept of the net relationship is positive ($34.3 Million + $14.5 Million = $48.7 Million). Therefore, the overall contribution of Consumer Surplus is positive up to the value of

KG-Demand = 109,000KG (where this is KG-Demand under the Status Quo scenario) – which is not reached until year 3.

Figure 5.19 Consumer Surplus Contribution to NPV
as a Function of KG-Demand (Status Quo) showing
a) Impact of Lower KG-Demand;
b) Impact of Higher Consumer Surplus Value per KG; and
c) Net (combined) Impact



Source: Delsys Research

5.3.3 Discussion of Results

This CBA has undertaken a careful, informed approach to the monetization of some of the major (but by no means exhaustive) anticipated outcomes of the proposed regulatory change for access to marihuana for medical purposes. This has attempted to capture meaningful and realistic behavioural reactions to the removal of licensed marihuana cultivation by individuals for their personal or designated-person use. This study thus documents a likely reduction in the number of adverse safety (i.e. fires) and security (e.g. misuse and home invasion) incidents that can be monetized in terms of social and security costs to society.

The CBA documents significant reductions in Health Canada Program Administration costs that are likely to arise as Health Canada ceases to be the principal medium of individual access to a legal supply of marihuana for medical purposes and focuses its regulatory effort on licensing and inspection of the commercial (legal) producers. These savings are significant, as the scale of the MMAP is expected to expand by about 750% in the ten year forecast period (for ATP persons in the Status Quo).

The impact on individuals authorized to access marihuana under the MMAR on the elimination of legal personal-production and designated-person production and its replacement by commercial supply will make the legal supply price higher, although this analysis does not

presently observe the transacted market price for Designated Person supply and only the supply price for Personal Use supply can be estimated. Also, only the likely LP Market price can be forecast. However, the Reference case, reflecting the best information and data available, indicates a relatively large supply price increase in the Policy scenario.

There is some possibility that the LP Market price could be lower than what is estimated in this analysis. This will only become known once the market is established in FY2014-15. Competitive market pressure between LP suppliers and greater production efficiencies, if supported by the Regulatory regime, may drive the supply price in the Policy scenario lower than this study's Reference case.

The impact of higher LP market price is a reduction in the KG consumed in the market. The effect of the elimination of legal own-production is not expected to result in the cessation of that activity but its curtailment, as a result of a higher expected probability of police action, arrest and conviction.

The reduction in the KG consumed in the market is reflected in the reduction in the Consumer Surplus measure that tends to dominate the overall NPV result. While the sensitivity analysis (in the next section of this report) demonstrates that there are realistic parameter estimates that generate a positive NPV, this analysis suggests that the Reference case result with a negative NPV is the single most likely CBA result.

The TBS Guidelines for Cost-Benefit Analysis direct the results to be summarized (primarily) in terms of the Reference case. This report presents them as such. These Guidelines also require a sensitivity analysis of the CBA results to investigate the range of NPV results that can arise from alternative, realistic parameter values. This is undertaken below. It is important to highlight that the results show considerable variability and that the Reference case finding of a negative NPV is not, in fact, statistically significantly different from zero in light of the standard deviation of the resulting NPV distribution[32].

[32] The mean and standard deviation of the NPV distribution, based on 10,000 Monte Carlo trials, are: μ (mean) = $-1,476M; σ (standard deviation) = $2,799M. As a rule of thumb, there is a 95% probability that this study's estimate of the mean lies within a bound of +/- (2*Std Dev) of the 'true' mean. As that range includes the value zero and this study's Reference case estimate of -$728M this analysis can not say that a Null Hypothesis that this study's estimate is equal to zero can be rejected (at the 95% confidence interval).

CBA Accounting Statement (Table 1)

PART 1: Deterministic Case — NPV Results & Sensitivity Analysis

Category of Impact	NPV	Annualized NPV	Year 1	Year 2	Year 3	Year 4	Year 10
1. Monetized							
Benefits			13,858,072	11,668,741	-2,632,240	-35,510,868	-300,334,092
Costs			21,751,670	40,342,656	53,649,222	65,787,863	170,944,178
Net Benefits (All)	-109,723,604	-16,352,053	35,609,742	52,011,396	51,016,982	30,276,995	-129,389,915
Net Benefits (Exc. Users)	1,004,940,153	149,765,717					
2. Quantified / Non-Monetized							
Benefits							
Reduction-Legal Users			-16,415	-26,903	-40,647	-58,288	-124,933
Reduction- Legal KG-Consumed			-40,838	-66,160	-102,392	-148,939	-357,221
Costs							
Reduction-Misuse (Residential)			-4,157	-7,365	-12,098	-18,638	-51,225
Reduction-Residential Fires			-30	-54	-85	-133	-350
Reduction-Fire-Injuries			-2	-2	-3	-6	-15
Reduction-Fire-Deaths			0	0	-1	0	-1
Reduction-Home Invasions			-10	-20	-33	-53	-157
Reduction-Non-Fatal Shootings			-2	-2	-4	-6	-17
Reduction-Fatal Shootings			0	-1	0	0	-3
3. Unquantified							
Benefits	There are additional benefits in terms of reduced health risks to family members as a result of mould/chemical exposure resulting from residential marihuana cultivation in the home. There are also other general benefits from removing marihuana cultivation from homes, e.g., reduced fear, reduced policing costs, higher property values, and reduced environmental impacts from chemical waste).						
B. Cost-Effectiveness Analysis	Not Applicable						

PART 2: Risk/Uncertainty

Category of Impact	Values of Risk Variables (Low-High Range)			Type of Probability Distribution (Distribution Parameters)	
1. Key Risk Parameters	Lo	Mean	Hi	Type of Distribution	Parameters
Designated Person - Supply Cost	$1.40	$2.80	$5.00	Uniform	Minimum - Maximum
Max % of Mean Annual Income	10%	15%	20%	Uniform	Minimum - Maximum
Price Elasticity of Demand	-0.50	-0.25	-0.10	Triangular	Minimum - Likeliest - Maximum
Personal Use - Supply Cost	$1.00	$1.80	$2.50	Uniform	Minimum – Maximum
Utilization Rate - Personal Use	40%	55%	65%	Uniform	Minimum - Maximum
Utilization Rate - Designated Person	35%	47%	55%	Uniform	Minimum - Maximum

2. Monte Carlo Simulation	Project Outcome Values (NPV)	
	Mean Value	-1,687,872,721
	Median Value	-1,342,604,699
Sensitivity Analysis Results	Standard Deviation	2,855,961,358
	Low	-26,289,518,277
	High	10,010,797,264

Source: Delsys Research – as per TBS (2007) p.42

5.3.4 Stakeholder Analysis

The reference scenario NPV of -$109.72 Million can be broken down by results attributable to different stakeholders. This is summarized in Table 2 of the CBA Accounting Summary (as per TBS guidelines) and shown in Figure 5.20.

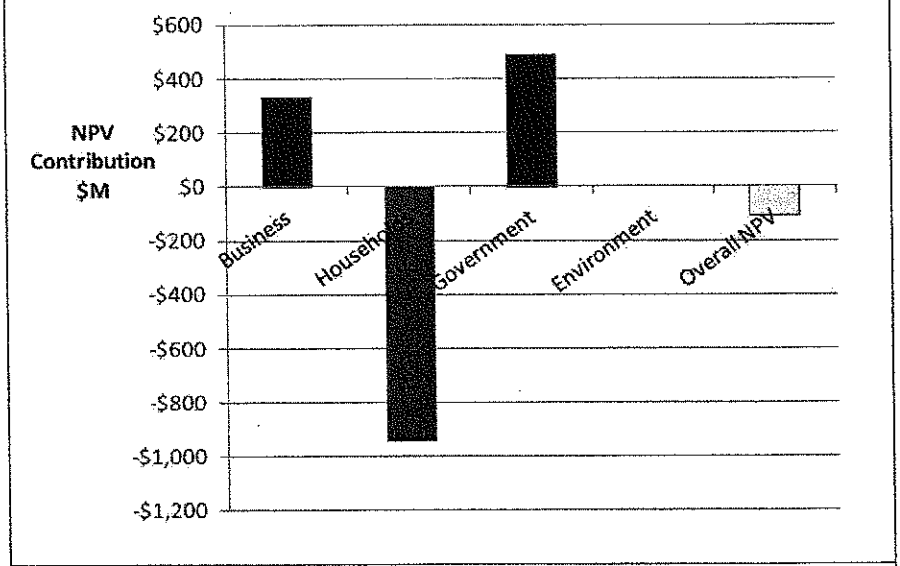
a) By Type of Stakeholder

Government (Federal Government) is the main beneficiary of benefits resulting from the Policy scenario through the reduction in Health Canada's Program Administration Costs.

Households, especially MMAP users, are the main stakeholder group impacted in terms of reduced Consumer Surplus benefits.

Businesses, especially Medium-Sized Businesses, are also a main beneficiary of the Policy scenario in terms of Producer Surplus benefits. It is important to note that Producer Surplus is not related to profitability and should not be taken as an indicator of such.

Figure 5.20 Composition of Reference Scenario NPV
By Stakeholder Type



Source: Delsys Research

CBA Accounting Statement (Table 2)

Stakeholder Impacts

Category of Impact	NPV	Annualized NPV	Year 1	Year 2	Year 3	Year 4	Year 10
Cumulative Net Impact	-109,723,604	-16,352,053	35,609,742	52,011,396	51,016,982	30,276,995	-129,389,915
1. Impact on Business							
Small Firms	7,622,719	1,136,010	2,368,944	5,674,077	0	0	0
Medium Firms	293,793,341	43,783,871	275,531	753,961	13,976,839	23,491,078	98,517,365
Large Firms	34,377,298	5,123,231	0	0	0	3,121,453	11,517,494
2. Impact on Households							
Participants in MMAP	-1,000,602,469	-149,119,274	12,002,322	13,110,613	-8,565,862	-58,585,004	-375,552,827
Non-Participants in MMAP	58,312,807	8,690,328	2,075,690	3,446,330	4,984,947	6,679,612	14,335,706
3. Impact on Government							
Federal Government	481,637,405	71,778,176	18,749,528	28,286,699	40,267,369	55,012,377	118,558,853
Other Government	11,081,795	1,651,514	137,728	739,715	353,689	557,479	3,233,494
4. Impact on Environment							
Not Relevant in Context	NA	NA	NA	NA	NA	NA	NA
5. Impact by Region							
Atlantic	-93,371,867	-13,915,162	2,222,267	3,051,185	970,316	-4,364,215	-38,001,962
Quebec	11,183,903	1,666,731	1,008,401	1,716,715	1,962,993	1,796,741	1,193,257
Ontario	199,063,164	29,666,281	24,567,758	35,888,291	41,784,033	41,018,600	6,015,633
Prairies / Territories	35,464,319	5,285,229	2,208,915	3,828,505	4,611,755	4,709,199	6,389,183
British Columbia	-260,950,029	-38,889,249	5,585,289	7,505,651	1,691,620	-12,821,928	-104,557,718

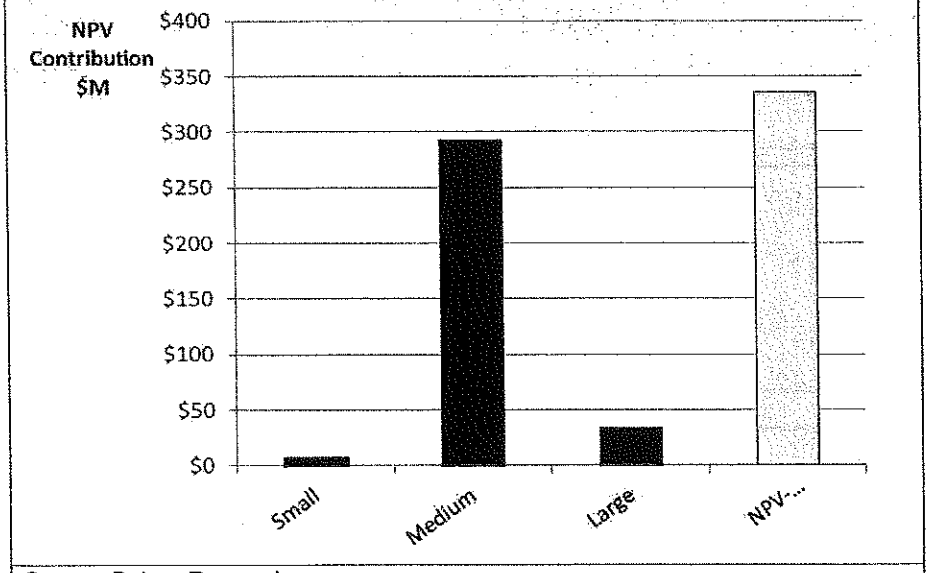
Source: Delsys Research – as per TBS (2007) p.43

b) By Size of Business

The Federal Government's regulatory streamlining initiatives place considerable focus on the elimination of business compliance costs and administrative burden on business, especially on Small Business[33].

The distinction between results in terms of size of business requires careful interpretation. Basically, all new LP entrants start as Small Businesses and grow to become Medium Businesses during the forecast period. Therefore, there is no real result specific to Small Business, as this is a transitory impact in the first two years, which is then overwhelmed by gains achieved – by the same businesses – over the balance of the forecast period as Medium-sized Businesses. This is shown in Figure 5.21.

Figure 5.21 Composition of Reference Scenario NPV
By Size of Business



Source: Delsys Research

[33] Small Business is defined as less than 100 employees and/or less than $5M in Sales Revenue. In the CBA model for this regulatory proposal, New Entrant LPs are all Small Businesses during the initial two years of their operation and grow to become Medium businesses after two years.

c) By Household Type

The CBA considered two types of households: a) those associated with a family member who accessed marihuana for medical purposes or with a family member who is a Designated Producer; and b) members of the general public. These are shown in Figure 5.22.

i. Households – Family Member Participating in the MMAP

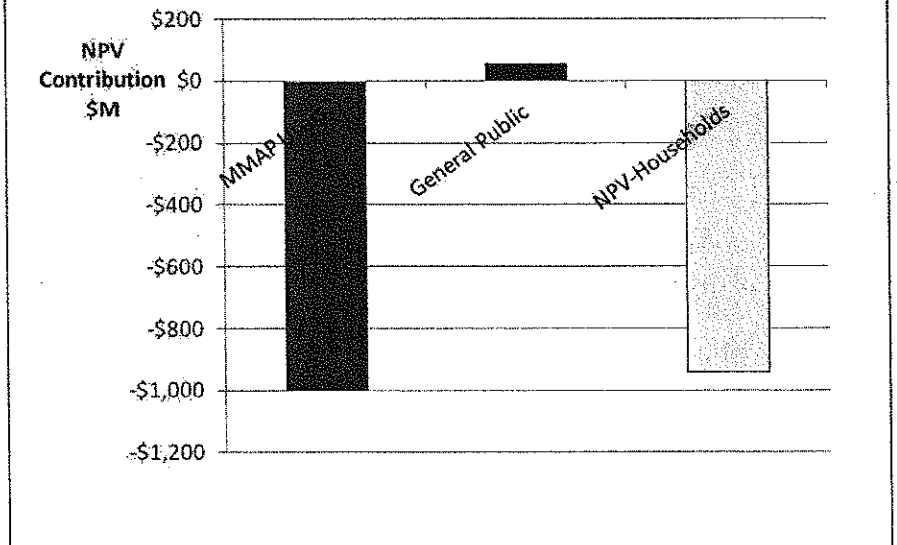
These households experience the loss of Consumer Surplus associated with more expensive marihuana and less quantity of marihuana consumed, the non-insured portion of fire property damage and the consequences of fire death and fire injury not attributed to firefighters, as well as the majority of home invasion consequences that are not attributed to the criminal justice system. Of these impacts, the monetary value associated with Consumer Surplus is the largest.

ii. Households – General Public

The General Public bears the Deadweight Loss associated with the market distortion arising from the effective subsidy or tax impact on regulated commercial marihuana supply, as well as the insured component of the property damage associated with fire events attributable to misuse of residential marihuana cultivation related to the MMAP.

It should be noted that, ultimately, the impacts on Governments (Federal and other) are also borne by these households as taxpayers. This value is not included, as Government is a separate Stakeholder in the analysis.

Figure 5.22 Composition of Reference Scenario NPV By Household Type



Source: Delsys Research

If we attribute the Government NPV benefit to the General Public i.e., as taxpayers, the bar in Figure 5.22 for the general public NPV would be almost $500M higher.

d) By Level of Government

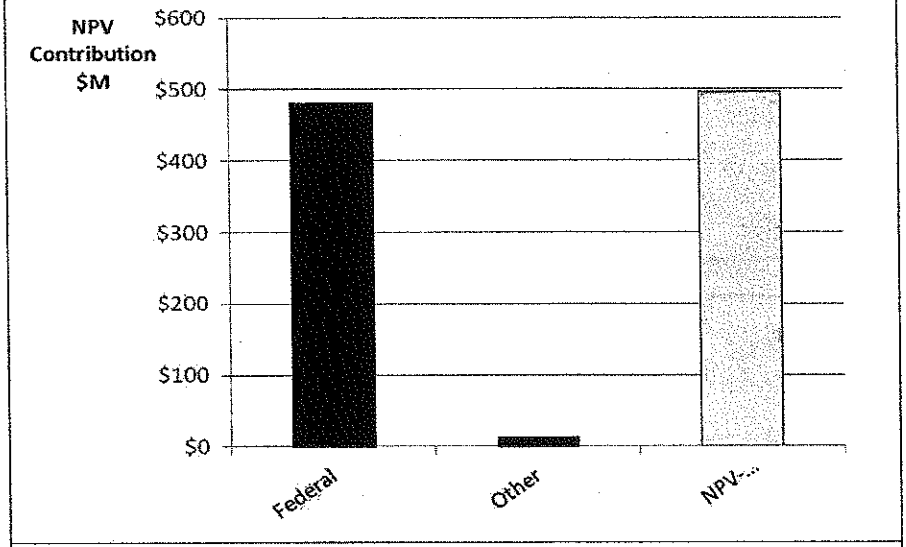
The Federal Government receives benefits from: a) the reduction in Health Canada – Program Administration Costs and b) a share of the costs of the criminal justice system as it pertains to Security social costs that are not borne by victims of Home Invasion crime.

Other Government receives benefits from: a) fire injuries sustained by firefighters associated with misuse of residential marihuana cultivation and b) a share of the costs of the criminal justice system as it pertains to security social costs that are not borne by victims of home invasion crime.

The bulk of Government benefits are related to the reduction in Program Administration cost and accrue to the Federal Government. This is shown in Figure 5.23.

It should be noted that, ultimately, the impacts on Governments (Federal and other) are also borne by the general public as taxpayers.

Figure 5.23 Composition of Reference Scenario NPV By Level of Government



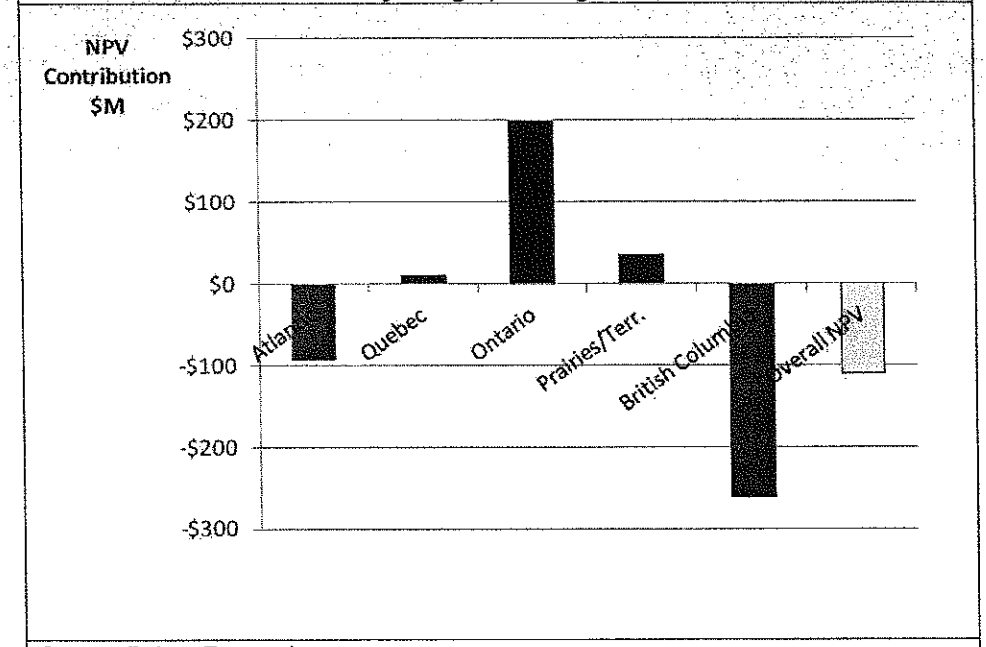
Source: Delsys Research

e) By Geographic Region

The CBA costs and benefits were allocated by geographic region of Canada according to known distributions of MMAP participation (which determines the bulk of the allocation) and an assumption about the expected locus of LP market production.

The large negative NPV attributable to British Columbia and the Atlantic[34] region result from their disproportionate share of MMAP participation in terms of persons authorized to possess marihuana for medical purposes. This is shown in Figure 5.24.

Figure 5.24 Composition of Reference Scenario NPV
By Geographic Region



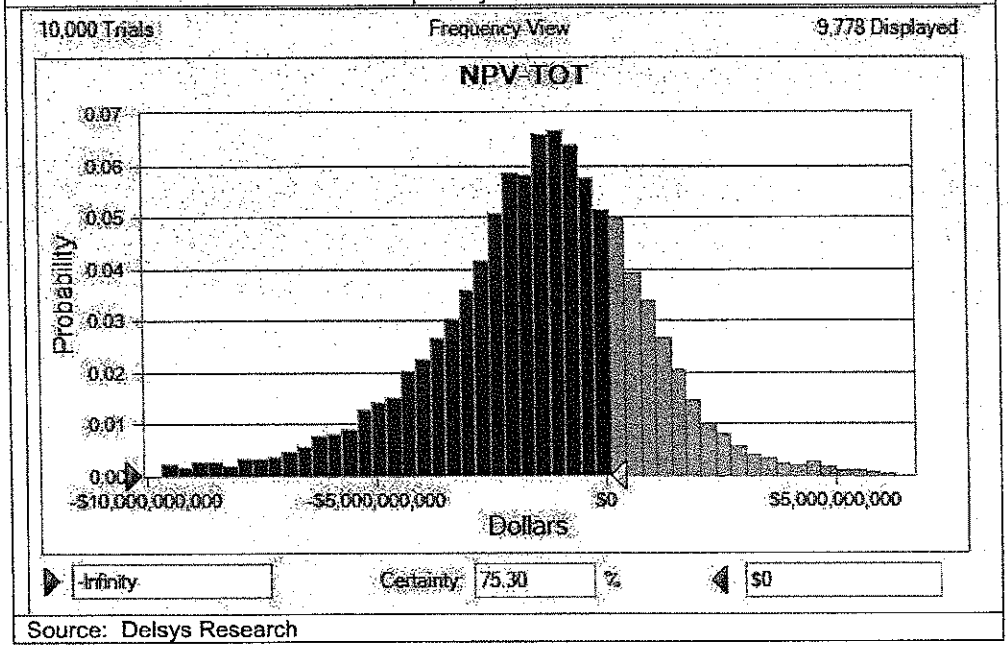
Source: Delsys Research

[34] The Atlantic region concentration of MMAP participation is largely driven by the high MMAP participation rates in Nova Scotia.

5.4 Sensitivity Analysis

The Monte Carlo simulation results, given the various assumptions and parameter distributions assumed in this model, are shown in Figure 5.25 and Table 5.7.

Figure 5.25 – NPV Result Distribution
Frequency Distribution



Source: Delsys Research

When the NPV distribution of results from the 10,000 Monte Carlo trials are examined, it is evident that the NPV central tendency is about -$1.690 Billion with a range from -$26 Billion to +11 Billion. About one quarter of all sensitivity trials resulted in a positive NPV.

Table 5.7 – NPV Result Distribution
Summary Statistics

Forecast: NPV-TOT		Forecast: NPV-TOT	
Statistic	Forecast values	Percentile	Forecast values
Trials	10,000	0%	-$26,289,518,277
Mean	-$1,687,872,721	10%	-$4,860,448,101
Median	-$1,342,604,699	20%	-$3,346,114,210
Mode	'---	30%	-$2,481,262,361
Standard Deviation	$2,855,961,358	40%	-$1,880,177,393
Variance	8.157E+18	50%	-$1,342,809,145
Skewness	-1.4200	60%	-$859,519,865
Kurtosis	9.02	70%	-$329,264,841
Coeff. of Variability	-1.69	80%	$310,124,093
Minimum	-$26,289,518,277	90%	$1,160,314,066
Maximum	$10,010,797,264	100%	$10,010,797,264
MSE	$28,559,614		

Source: Delsys Research

Investigation of the trials for which there is a positive NPV showed that such trials were more likely to be associated with:

- lower Status Quo scenario supply prices (combined across the three supply markets), primarily lower Designated-Person supply price and Personal-Use supply price;

- relatively higher consumption in the Policy scenario as a result of more Grams Per Year and a lower proportion of cases (21% of trials with positive NPV) for which the affordability constraint was operative (compared to 61% of trials with negative NPV) and/or higher maximum percentage of mean annual income comprising that affordability constraint; and

- more inelastic demand in the Policy scenario (although more elastic than the Status Quo) which results in a higher Demand intercept and slope[35].

The first of these reduces the Consumer Surplus measure in the Status Quo scenario. The second and third increase the Consumer Surplus measure in the Policy scenario. In all of these cases, there is considerable variability in the range of parameters that can generate a positive NPV result. This study looked at the mean value of various parameters for trials for which the NPV result is positive and compared this to means values for trials for which the NPV result is negative.

5.4.1 **Key Parameters**

The sensitivity analysis, Figure 5.26, shows the most important assumptions that give rise to variability for the NPV-Total result. The most important assumptions, in terms of contribution to variance, are:

DP-Cost - the Supply Cost (reference case = $2.80/gram) for Designated Producer in the Status Quo scenario.

PC-INCOME - the Maximum % of Mean Annual Income (for Users) that the Annual Cost of Marihuana Supply can account for (reference case = 15%).

P-ELAS-SQ - the Price Elasticity of Demand (reference case = -0.25) for all users in the Status Quo scenario.

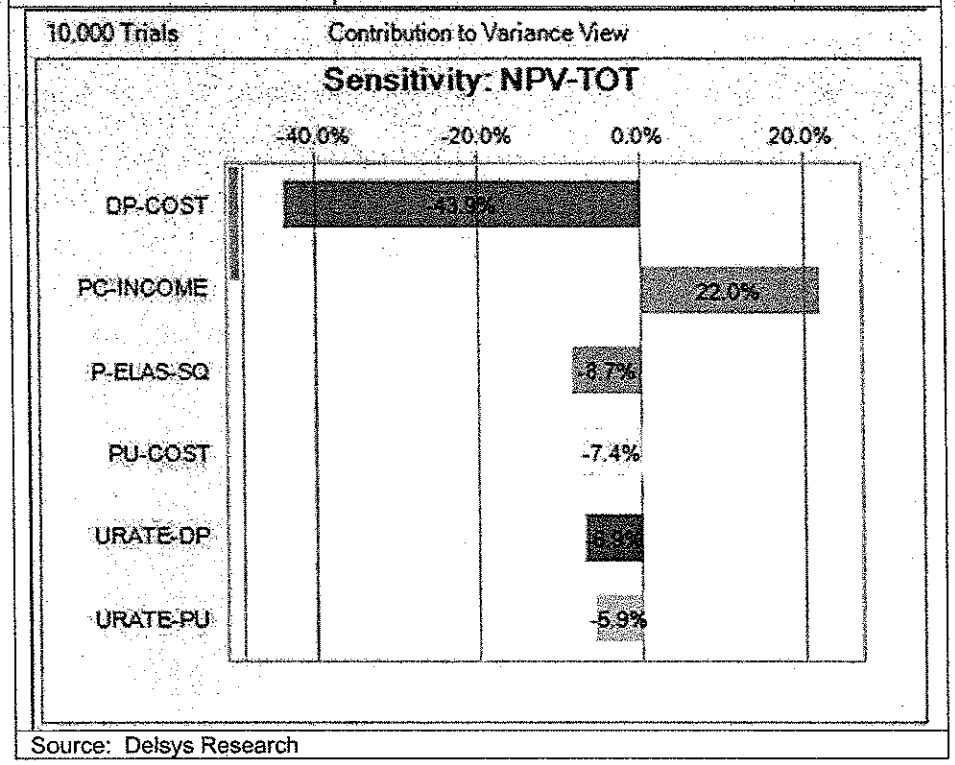
PU-Cost - the Supply Cost (reference case = $1.80/gram) for Personal Use in the Status Quo scenario.

URATE-DP - the Utilization Rate for Designated Persons in the Status Quo scenario, which is a ratio of the estimated actual usage relative to a theoretical maximum quantity based on the Proposed Daily Amount (9.0 grams) included in the ATP application by the user.

[35] More elastic demand in the Status Quo scenario leads (generally) to fewer legal users of Marihuana for Medical Purposes in the Policy scenario.

URATE-PU - the Utilization Rate for Personal Use in the Status Quo, which is a ratio of the estimated actual usage relative to a theoretical maximum quantity based on the Proposed Daily Amount (7.6 grams) included in the ATP application by the user.

Figure 5.26 – NPV-Total Sensitivity
Assumption Contribution to Variance



Source: Delsys Research

Further assessment of the sensitivity analysis shows the rank correlation between each of these important assumptions and the NPV result:

DP-Cost	ρ = -.50 to NPV
PC-INCOME	ρ = .35 to NPV
P-ELAS-SQ	ρ = -.22 to NPV
PU Cost	ρ = -.21 to NPV
URATE-DP	ρ = -.20 to NPV
URATE-PU	ρ = -.18 to NPV

For further discussion of response functions for key parameters of the CBA model, refer to Annex 2.

5.4.2 Discussion – Uncertainty in Quantitative Modeling

The most important finding of the sensitivity analysis is the considerable variation in possible NPV results from realistic parameter values and the complex interactions that are captured in the model.

This variability does not diminish the sense that the Reference case is the single most likely result.

The variability does reflect inherent uncertainty of the impacts of the proposed regulatory change. There are several key aspects of this variability, which is another way of reflecting regulatory risk:

1. Rapid Growth of the MMAP;
2. Fundamental Change;
3. Complex Dynamic Behaviour;
4. Establishment of a New Market; and
5. A Wide Range of Plausible Outcomes.

1. Rapid Growth of the MMAP

The MMAP has grown exponentially at an average annual rate of 40% for more than eight years. While it is believed there is a ceiling (upper limit) to future growth, it is expected that this will not be reached until the end of the forecast period. As a result of this inherent growth, the values involved (e.g., users, KG consumed, Administration Costs, safety and security events) are expected to change substantially. Any time that there are such large growth factors, there is an inherent risk regarding forecast accuracy and confidence levels over the forecast period.

One important qualitative impact, which the literature on drug crime prevention (which forms part of the policy rationale for proposed regulatory change) has identified, is that such crime prevention has a higher probability of success when the market is relatively small and emerging. While the illicit marihuana market is mature, the levels of MMAR misuse of residential home cultivation of marihuana are quite small (in FY2012) compared to the levels that are expected to arise by the end of the forecast period (FY2023-24). This suggests the need for reform of the regulatory regime before the scale of authorized cultivation of marihuana for medical purposes in homes grows further. It will be much harder (and possibly less successful) to reduce this activity (once declared illegal as a result of the elimination of PUPLs/DPPLs) if the policy change were delayed for five or ten years.

2. Fundamental Change

Regulatory change modelling is much easier and more certain when reform is incremental in nature. The proposed regulatory change for access to marihuana for medical purposes is more fundamental, especially the elimination of PUPLs/DPPLs which comprise 80% of user supply, in terms of persons, and the bulk (perhaps 97%) of legal KG supply.

It is unreasonable to believe that all residential marihuana cultivation that would have occurred under MMAR (and misuse) will cease as a result of its prohibition. This study has thus modelled a behavioural response that depends on the probability of conviction and builds in an effect which reflects the current inhibition that law enforcement authorities have stated exists with respect to their ability to take investigative police action once a problem resident (association with a MMAR production license) is identified. Once that inhibition is removed (a process of increasing clarity by eliminating the additional evidence required to obtain reasonable and probable grounds to investigate potential misuse), it is anticipated that there will be a deterrence effect on misuse associated with residential marihuana cultivation.

This study also anticipates that the effective supply price for marihuana for medical purposes will increase as LP Market supply is projected to be more expensive than PUPL/DPPL supply. It is expected that there will be a price elasticity effect that will consequently reduce the quantity of marihuana consumed for medical purposes in the Policy scenario LP Market relative to what would have been consumed in the Status Quo. This is the price effect.

Both the deterrence and price effects involve fundamental and large regulatory changes whose outcomes on behavioural change are inherently difficult to predict.

3. Complex Dynamic Behaviour

Human behaviour, in terms of criminal activity, crime prevention, market entrance and market demand), involves complex interactions and options. For the purposes of modelling the regulatory impact, this study assumed a degree of individual rationality and predictability of human behaviour in response to incentives (rewards and penalties).

That production activities which are authorized under the current MMAR will, under the proposed regulatory change, become illegal, raises an issue of regulatory compliance. Access to marihuana for medical purposes remains a debated subject of public policy[36]. By some Canadian public opinion evidence, Canadians appear divided on issues regarding the criminality (and morality) of marihuana use. This divided public opinion, and the sense that many Canadians may believe they have a right to access marihuana[37], means that the degree of compliance with the proposed regulatory change is uncertain.

4. Establishment of New Market

[36] Not to mention the broader policy of marihuana decriminalization, which is outside the scope of the proposed regulatory change and this CBA.

[37] Canadian court decisions, which underpin the MMAR regulatory regime, appear to recognize a right to access a legal supply of marihuana for medical purposes.

Most regulatory analysis deals with legal activities for which there is some history and experience in terms of market outcome. In the case of marihuana for medical purposes, the current MMAR regime has three distinct markets, of which only one (the Designated-Person supply market) might reflect a competitive market outcome. However, the market outcome in this case is not observed by Health Canada (as the regulator of participation in the MMAP).

The elimination of PUPLs/DPPLs and the termination of the contract governing the Government Supply market will bring about the establishment of a new LP Market.

This CBA study has attempted to estimate and anticipate likely demand and supply parameters for this market.

Market dynamics, in terms of entry of new LP suppliers, the growth of the existing incumbent (i.e., Contract Government Supply provider), the response of users to higher prices, and the elimination of legal residential marihuana cultivation, are complex and uncertain.

There is also a high degree of financial/business risk that Licensed Producers will face in the establishment of this new market.

5. A Wide Range of Plausible Outcomes

All of the above factors suggest that the analysis cannot project with any certainty, what the initial post-transition (i.e., phasing out of MMAR authorizations and production licenses) market outcomes will be, nor what these market outcomes will be in FY2023-24.

The broad variability of NPV outcomes, as reflected in the NPV Result distribution, is a simple quantified reflection of the underlying uncertainty and risks inherent in the proposed regulatory change.

5.5 Qualitative Discussion

5.5.0 Reference Case Qualitative Impacts

The Reference case generates a negative Net Present Value result and is based on reasonable assumptions that are inherently uncertain. Note that certain factors (i.e., impacts, behavioural responses) have been excluded from the quantitative CBA as there is insufficient information on which to assess the factor. As such, the quantitative analysis does not tell the full story of the overall impact of the proposed regulations. There are costs and benefits – possibly significant in size – that could not be quantified but which are relevant for public policy purposes.

The following subsections examine the qualitative impacts that are applicable across all of the scenarios considered under the probabilistic analysis, and discuss some core issues and trends which are likely to result from the proposed changes to the regulation (and creation of the new industry). Before these issues are examined in depth, however, it bears examination which qualitative impacts will (or will not) be evident under the Reference case.

Perhaps the most notable impact of the Reference case, and of the program in general, is the introduction of a regulated marihuana production and distribution industry (for the use of marihuana for medical purposes) into the Canadian economy. The proposed marihuana

access program will create hundreds of new jobs across Canada within the projected ten-year period. As private businesses, the licensed producers/distributors will be subject to scrutiny and attention from the public as well as the media. This process may inhibit marihuana production that operates outside the bounds of the law (i.e., at least as it pertains to marihuana use for medical purposes) and raises questions as to the product safety of using illicitly-obtained marihuana. Just as bootleg whiskey is considered to be more dangerous and more variable in quality in relation to a quality-controlled product available from a regulated industry, so too could a regulated marihuana for medical purposes industry make the illicit product less attractive over time.

Under the Reference case, a reduction in the alleged misuse of marihuana for medical purposes is anticipated. However, not all criminal activity will cease. The proposed regulations provide certain safeguards against illicit diversion from licensed producers: a) the requirements and background checks prescribed by the new regulations are significant; and b) the significantly lower number of entities subject to regulation, enforcement and monitoring by Health Canada should allow for more effective management and greater compliance over time.

The quantitative CBA includes calculations as to the impact of ending personal and designated person production, both of which involve fire hazards, crime risk and concern as to the evidentiary requirements in investigating potential misuse. From a qualitative perspective, this is one of the most noticeable impacts of the new policy structure. Whereas law enforcement authorities previously encountered difficulty in determining which residences where marihuana was being produced were operating outside the law, the proposed regulations provide certainty that any residence conducting marihuana cultivation will be strictly outside the law and subject to enforcement. This regulatory simplification should increase the effectiveness of law enforcement efforts and result in improvements in compliance dynamics.

The Reference case assumes that the new industry will ramp up and become competitive quickly. While the first six months of the transitional period will be challenging for most new LPs, the already significant and growing demand for product will justify additional investment and short-term staffing/production to smooth over the difficult start-up phase that is likely to be experienced by many new licensed producers.

Once LPs are up and running, additional qualitative factors may come into effect. The regulations specifically will not allow the advertisement of marihuana to the general public. However, the marihuana for medical purposes client base tends to be socially connected and capable of using social networks to quickly spread information informally. While LPs will not be able to advertise their products in a conventional sense there is likely to be a strong incentive for individuals accessing marihuana from LPs to share information (e.g., with respect to pricing, delivery, customer service, personal perceptions of the impact of usage, etc.) among themselves, and support the creation of brand identities – even without LPs having the legal ability to manage this process overtly.

This informal branding/advertising structure may have two impacts: a) it will raise awareness of the new system and LP industry; and b) it will provide a means for the regulator and for LPs to conduct market research on consumer attitudes, word-of-mouth response with respect to all products and LPs in the market.

The first effect is akin to restaurant reviews using social networking which will increase the power of the word-of-mouth dynamic for branding and product differentiation.

The second impact is akin to an early warning system and provides customer informal feedback and customer preference indicators with respect to product/service characteristics (e.g. price responsiveness, product perception, service experiences, customer problems) which provides the opportunity for product/service adaptation and improvement.

The Reference case projects the continued growth of marihuana for medical purposes usage in Canada and assumes that medical professionals will continue to expand their support of patient access. The Reference case projects that the average cost of a gram of marihuana will increase under the new regime over the average supply price under the existing MMAR regime, largely due to the elimination of lower cost personal-use and designated-person production. From a qualitative perspective, there are two price-response factors that can be identified: a) the legal supply price (for marihuana for medical purposes) is expected to remain below the illicit street price for marihuana (for retail quantities); and b) market dynamic forces may lead to product improvement over time from R&D and, potentially, investment in science to meet the Health Canada requirement for authorization as a therapeutic drug.

The expected LP price will likely be less than that of the illicit market. Persons wanting to access marihuana for medical purposes are therefore, it is suggested, unlikely to want to access their product from the illicit street supply. It is anticipated that the market demand for marihuana for medical purposes usage is driven by a perception that this is an effective means of treating certain health conditions. An increase in the 'legal supply' price (i.e., the price for the LP market is expected to be above that for the MMAR supply markets) may result in users (and potential future users) considering alternative treatment options and/or in using less marihuana for medical purposes. Assuming that the projected increase in the Status Quo for use of marihuana for medical purposes is fully reflective of legitimate health conditions, there will be no diminution of the underlying demand for idiosyncratic pain relief or other perceived benefits to individuals.

The complex relationships and interactions between price, access, quality and demand in the Status Quo scenario, Policy scenario and (implicitly) in the illegal market, are captured to a large degree in the Reference case of the CBA where a large and growing number of users remain "willing to pay" for marihuana for medical purposes from LPs in the Policy scenario despite the higher price compared with the Status Quo scenario.

It is anticipated that LPs may have an incentive to invest in R&D and scientific study of the use of marihuana products/delivery methods as recognized medical therapy. This will especially be the case if profitability is high and market growth remains strong. The potential for strong profitability (given regulatory and commercial entry requirements) can spur innovation, which has not been factored into the CBA results.

These are some of the key qualitative impacts of the Reference case pertaining to market dynamics. The following subsections examine other potential impacts.

5.5.1 Safety and Security

A major objective of the regulatory proposal is to enhance public and personal safety and security in Canadian residential communities. The benefits of achieving this objective are captured to a large degree in the quantified CBA.

However, the literature review, stakeholder consultations and other sources indicate some additional benefits regarding public and personal safety and security. These additional benefits are more difficult to quantify and monetize because of the absence of data relevant to the Canadian context. For example, additional improvements in health, quality of life, and the environment will result from the reduced presence and health/safety risks of mould, chemical contamination and problems that are associated with production of marihuana in small, enclosed spaces in private residences.

Improvements in the quality of life and the physical environment are likely to lead to higher residential and other property values. It may also lead to lower home insurance costs for households and businesses in the communities which experience a decrease in the production and misuse of personal use and designated production now taking place under the MMAR regime. The improvement in law enforcement clarity and effectiveness of police resources could allow for better law enforcement outcomes and greater deterrence effect from drug crime policing.

5.5.2 Reduced Information, Administration and Related Transaction Costs

The regulatory proposal is designed to reduce the information, administration, and related transaction costs for access to a regulated supply of marihuana for medical purposes. Compared with the Status Quo scenario, the regulatory proposal (Policy scenario) involves less costly administrative requirements for users/patients and physicians to access a regulated supply of marihuana for medical purposes. While the program administrative costs facing Health Canada has been reflected in the CBA results these patient/health professional benefits have not been included. The time and effort savings under the Policy scenario from a shorter form, reduced processing steps (e.g., no application to Health Canada, no requirement for medical specialist consult) are difficult to quantify but are recognized to be real and tangible.

It is possible that less costly and more timely access could result in greater use uptake than has been forecast and reflected in the CBA results. In particular, removing the government from the physician-patient interaction, eliminating the categories of conditions or symptoms for which an individual may possess marihuana for medical purposes, removing the requirement for some individuals to consult with and obtain permission from a specialist, and simplifying the form to be filled out by the doctor should:

(i) reduce the information and transactions costs and related delays and risks of both physicians and their patients, and

(ii) make the interaction quite similar to doctor/patient discussions on other drug and medical therapies.

Physicians and patients that may have been discouraged from participation in the MMAP in the Status Quo scenario could have some of these impediments overcome by the proposed regulatory changes. This could expand market demand and result in additional incremental benefits of the Policy scenario.

Information was provided through stakeholder consultations with Health Canada regarding administrative and other cost savings, including for certain municipal government functions. The Policy scenario could lead to lower costs and/or greater effectiveness of municipal law

enforcement, fire protection and related services (e.g. by law enforcement) as a consequence of reduced fire risk and reduced misuse associated with residential marihuana production.

5.5.3 Establishment of a Competitive and Innovative Industry

The regulatory proposal will eliminate licensed personal-use and designated-person production (and the current government-contracted supply) of marihuana. It is anticipated that the regulated LP market will grow to be reasonably large (e.g., sales >$1 Billion per year), competitive (perhaps ~50 suppliers) and profitable – which over time has the potential to lead to innovation. The LP market could have the incentives, resources, ability and competitive pressures to undertake (over time) investment in R&D and product, process and organizational innovations that could result in the following[38]:

(i) Economies of scale and scope, accumulated learning, and related internal and external efficiencies;

(ii) Higher yields; lower production, overhead, handling, shipping and other costs; and higher quality products, better strains and greater product variety that better meet the diverse needs of their customers (i.e., some of these dynamics could lead, over time, to reduced product prices [Hazekamp (2006, 2007)];

(iii) User social-networking that will result in shared information and learning between LPs, Health Canada and other government agencies that may lead, over time, to lower compliance, administration and related regulatory costs that will achieve desired regulatory objectives; and

(iv) Industry research and public research to expand the scientific knowledge base regarding the medical efficacy and toxicity of marihuana products and ingestion methods as potentially approved therapies

5.5.4 Potential Benefits and Risks of "Reverse Diversion" from the Illicit Marijuana Industry and Other Legal and Illegal Substances to the Marihuana for Medical Purposes Industry under the Policy Scenario

An extensive body of literature on cannabis/marihuana use suggests the possibility of an unintended consequence of a regulated marihuana production and supply industry. Over time, a regulated market could be characterized by: monopolistic competition based on product differentiation and lesser price elasticity; and a product substitute for persons seeking alternative methods for alleviating pain and other condition symptoms.

Furthermore, the existence of a regulated marihuana supply at a price below the illicit street price raises the potential for what may be referred to as "reverse diversion." This term refers to the desire to substitute illicit marihuana supply with a less expensive supply for reasons other

[38] The diagram Annex I section 5 uses comparative statics analysis to illustrate how user demand and consumer surplus could increase in the future through the combined effects of these dynamic factors. The potential for greater consumer surplus, higher producer surplus, and other economic and societal benefits from the dynamic industry and market changes associated with the Policy scenario over the longer term is the consequence of a number of the pro-competition and pro-innovation features of the Policy scenario compared with the Status Quo scenario.

than medical purposes. The potential demand for access to a legal supply of marihuana may be greater than projected in the CBA[39].

The literature review and stakeholder consultation process both indicated that "reverse diversion" could lead to net incremental benefits. Lower quality-adjusted prices are possible, over time, under dynamic market behaviours. These could generate greater consumer surplus for each user (i.e., infra-marginal gain) as well as greater consumer surplus from induced users (i.e., extra-marginal gain).

The literature suggests that, over the long term, growth in market size, market competitiveness and market innovation capabilities (aided by "reverse diversion" and other processes) could result in decreased abuse of alcohol, marihuana, hard drugs and certain prescription drugs for relieving pain that are reportedly causing problems. As a consequence, additional user and societal benefits could result from the reduction in the addiction, abuse, crime, health, and other problems and government and social costs that are currently associated with alcohol, hard drugs and certain prescription drugs [Payne (2012) and Kilmer et al (2010)].

The process of "reverse diversion" is not without certain costs and risks, however. The illicit drug market has a reputation for responding flexibly, aggressively, and (sometimes) effectively to various market, legal and other risks that threaten its customer base, revenues and profits. Producers, importers and dealers in the illicit market may respond with violence, intimidation, sabotage, theft and other criminal acts when faced with the risk of losing customers to the legal supply market for marihuana for medical purposes. They could also engage in standard economic responses such as predatory pricing, non-price predation and other anti-competitive conduct directed at participants in the legal market and industry [Becker et al (2006) and Rhodes et al (2000)].

The potential for "reverse diversion" is a risk to the undermining of public confidence in the proposed regulatory regime. The public might perceive rapid growth based (in part) on reverse diversion as an abuse of the proposed regulatory regime that was intended to be restricted to persons seeking alleviation of medical conditions under physician or other health care practitioner supervision.

5.5.6 Limitation of CBA

This CBA is intended to quantify the most likely Reference case Net Present Value result, as well as a sensitivity analysis of the NPV Result distribution. The associated qualitative analysis adds further context to the quantitative CBA results.

Government policy decision-making often is based on factors, judgments and priorities that are unlikely to be reflected in a CBA study. Practitioners of CBA are aware of this reality and have been guided to recognize the limitations of their tools, data and analysis.

This CBA study is a fair and reasonable reflection of quantitative and qualitative measures to evaluate the proposed regulatory changes to access to marihuana for medical purposes. It is offered in full accordance with Treasury Board Secretariat Guidelines for Cost-Benefit Analysis.

[39] It is also possible that the rapid expansion of the existing MMAP (and its projected future growth in the Status Quo scenario) is also a result of similar desire to access marihuana for other than medical purposes.

The order of magnitude of the quantitative CBA results reasonably account for the most important aspects of the policy rationale related to the proposed regulatory change. These CBA results may not, however, reflect the weight, priority and valuation of factors leading to the development of the proposed MMAR regulatory change. The CBA results are one form of regulatory analysis, among others, that have been undertaken in accordance with the Federal Government regulatory impact assessment requirements.

CHAPTER SIX

6.0 Conclusions

The monetized CBA results, in terms of Discounted Net Present Value, show that the expected benefits and costs of the proposed Regulatory change fall onto different stakeholders in varying degrees of impact.

There is no clearly Pareto superior result that supports a statement that one scenario (i.e., Status Quo or Policy) is superior to the other. The fact that the Reference case NPV is negative (-$109.72 Million) indicates that the sum of benefit and cost changes across all stakeholders is negative. The sensitivity analysis of the NPV result clearly shows a wide range of possible outcomes with a central tendency that is not statistically different from zero.

The analysis of the Reference case by stakeholder group shows that one class of stakeholder bears a cost in terms of NPV impact - namely the users of marihuana for medical purposes - while the remaining stakeholders (e.g., the general public, government, licensed producers) are made better off. This is a classic result that demonstrates there is no Pareto superior outcome and that economic analysis methods (such as Cost-Benefit Analysis) cannot, unequivocally, state that one option is better than the other. In such cases it is traditional to rely on priority judgements by policy makers to indicate which option is superior in terms of social welfare.

Both the quantitative and qualitative CBA results reflect the following factors:

i) rapid program uptake and continued growth;

ii) the fundamental nature of the regulatory change;

iii) the complex dynamic behavioural changes that could occur as a result of the elimination of residential marihuana cultivation and its replacement by higher cost commercial supply;

iv) the uncertainty surrounding the establishment of a new industry and market; and

v) the inherently unknown final outcome of the regulatory change after ten years.

It is important to bear in mind that while, from an economic perspective, user benefit is measured from the consumption of marihuana for medical purposes in terms of consumer surplus, the available scientific evidence does not support the authorization of marihuana use for therapeutic purposes under the Food and Drugs Act and Regulations. Canadian courts have ruled that individuals have a legal right to possess marihuana for medical purposes and that the Government of Canada has an obligation to provide reasonable access to a legal supply of marihuana for such medical purposes.

The consumer surplus measure of user benefit does not purport to show, and should not be taken as evidence, that there is any quantifiable medical benefit attributed to the consumption of marihuana for medical purposes.

Policy makers, apparently, have attributed much more weight to the negative impacts on social welfare that have been shown to arise from higher safety and security risks attributable to residential marihuana cultivation, and to the much higher program administration costs that would fall on Health Canada if the Status Quo were maintained and significant future growth in MMAP participation were to be accommodated. These have been monetized and quantified as best as possible and they are significant in number and value. While the Reference case does not show these to outweigh the loss of consumer surplus, it may be that the application of a social valuation to these impacts (from an economic perspective) may not adequately reflect a social valuation of the maintenance of public safety and security.

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ANNEX 1 – Consumer & Producer Surplus with Subsidy

1. Consumer & Producer Surplus – Impact of Subsidy

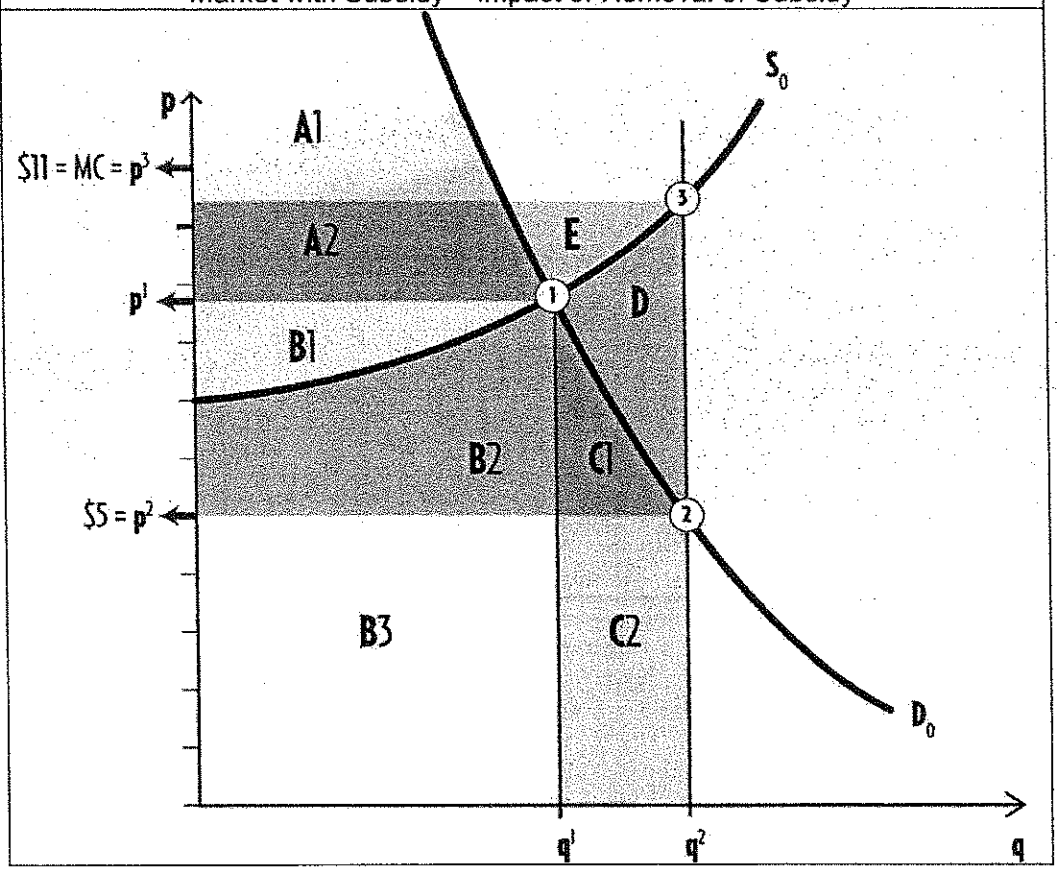
The graphic calculation of Consumer Surplus (CS) and Producer Surplus (PS) is described in a market with an upward sloping Supply curve (S_0) and a downward sloping Demand curve (D_0) that intersect at point 1. This is seen in Figure A-1.

Figure A-1 is used to assess the social welfare consequences of an introduction of a subsidy. First, the outcome of a market without a subsidy is viewed; then changes are observed when a subsidy is introduced.

Equilibrium – No Subsidy (Figure A-1)

The market equilibrium in the absence of any subsidy is found at the intersection of the Supply and Demand curves at point 1 and involves price p^1 and quantity q^1. In a perfectly competitive market the marginal cost of production is equal to p^1 (where the Supply curve shows rising marginal cost as quantity increases in the market) and the marginal willingness-to-pay is also equal to p^1 (where the Demand curve shows falling marginal willingness-to-pay as quantity increases in the market). Total market revenue is $p^1 * q^1$ and is equal to the sum of areas B1+B2+B3 in Figure A-1 (see next page).

Figure A-1 – Consumer & Producer Surplus
Market with Subsidy – Impact of Removal of Subsidy



Consumer Surplus is the area below and to the left of the Demand curve and above the price line at p^1. This equals the sum of areas A1+A2. It represents the amount of consumer willingness-to-pay that exceeds the out-of-pocket expense to secure quantity q^1 in the market. It is a benefit to consumers that is not captured in the market transaction through the price of the good.

Producer Surplus is the area above and to the left of the Supply curve and below the price line at p^1. This equals the area B1. It represents the amount of producer revenue that exceeds the total variable cost to produce quantity q^1 in the market. It is a benefit to producers that is captured in the market transaction through the price of the good.

Equilibrium – With Subsidy (Figure A1)

An allowance is now made for the existence of a price subsidy. The form of the subsidy (i.e. how it is paid) is less important than its existence and impact on market behaviour. The subsidy means that consumers can purchase the good at a price that is below what producers receive for providing the good. The quantity produced and sold in the subsidized market q^2 will be larger than the equilibrium quantity in the absence of the subsidy q^1.

In Figure A-1, consumers will effectively be at some point 2, such that at the traded quantity q^2 the price they face is p^2 and is less than the equilibrium price p^1 without the subsidy. Producers

will conversely be at some point 3, such that at the traded quantity q^2 the price they receive is p^3. The subsidy s (per unit of output) is equal to the difference between the two prices (p^3-p^2 = s) and the quantity demanded equals the quantity supplied at q^2.

While the operation of the market in terms of prices at the quantity q^2 has been explained, the actual market operation is in the reverse order. The existence of the subsidy per unit s generates a subsidy wedge and the subsidized market equilibrium quantity q^2 is determined where the quantity demanded equals the quantity supplied for the given value of the subsidy s.

The subsidy value is the value s * q^2 and is represented in Figure A-1 by the sum of the areas A2+B1+B2+C1+D+E.

The treatment of what is Consumer Surplus and Producer Surplus is complicated by the existence of the subsidy.

The logic used above, which took the Consumer Surplus to be the area below and to the left of the Demand curve and above the price line at p^2, would lead one to believe that this can be measured by the sum of the areas A1+A2+B1+B2+C1. This is obviously larger than in the market equilibrium case. However, the existence of the subsidy does not allow us to associate that area with Consumer Surplus.

The logic used above, which took the Producer Surplus to be the area above and to the left of the Supply curve and below the price line (i.e. at p^3), would lead one to believe that this can be measured by the sum of the areas B1+A2+E. However, the existence of the subsidy does not allow us to associate that area with Producer Surplus.

A new concept, Deadweight Loss, is used to refer to the value of resources consumed in production that exceed (at the margin) the value associated with consumer willingness-to-pay. In the subsidized market, this is the area above the Demand curve and below the Supply curve to the right of the marketing equilibrium point 1 (i.e. in the absence of the subsidy). This is the area D in Figure A-1. This Deadweight Loss is a social loss of productive resources that have been allocated to a use (the production of the good) for which the cost of the resources exceeds the marginal value ascribed to them by consumers (i.e. in their transformed state of the good produced and consumed).

For the purposes of ascertaining Producer Surplus, the lower price p^2 is effectively taken as the appropriate measure of the marginal social valuation of the use of the good. There is, therefore, no Producer Surplus in the subsidized market equilibrium.

Conversely, when measuring Consumer Surplus, the higher price p^3 is effectively taken as the appropriate measure of the margin social cost of the resources used in the production of the good. Therefore, the Consumer Surplus is the area A1 in Figure A-1.

Table A-1 summarizes the impacts on price, quantity and this study's welfare measures of Consumer Surplus, Producer Surplus and Deadweight Loss.

Table A-1 - Consumer Surplus, Producer Surplus & Deadweight Loss In a Market with a Subsidy (Figure 1) Showing Various Results With No Subsidy and With a Subsidy		
Variable	No Subsidy	Subsidy
Price to Seller	p^1	p^3
Price to Buyer	p^1	p^2
Subsidy (per unit)	zero	$s = p^3 - p^2 > 0$
Equilibrium Quantity	q^1	q^2
Value of Subsidy or Value of Transfer	zero	sum of area A2+E+B1+B2+C1+D
Consumer Surplus	sum of area A1+A2	area A1
Producer Surplus	area B1	zero
Deadweight Loss	zero	area D

The introduction of a subsidy involves:

- an increase in quantity demanded and supplied (i.e. $q^2 - q^1$);
- the transfer of value to producers and consumers (usually from taxpayers) equal to the sum of the areas A2+E+B1+B2+C1+D and which equals $s * q^2$ in value;
- the Deadweight Loss equal to area D;
- the elimination of Producer Surplus equal to area B1; and
- the reduction in Consumer Surplus equal to area A2.

In terms of a CBA measure of social welfare change, the transfer enters as a transfer and is neither a gain nor a loss. It is considered a transfer of resources from one owner (perhaps the taxpayer) to another owner (consumers and/or producers).

The only changes that are meaningful from a CBA measure of social welfare, involve the Deadweight Loss (area D), the elimination of Producer Surplus (area B1) and the reduction in Consumer Surplus (area A2). As all these involve a loss of social welfare, it suggests that the introduction of a subsidy in the market for this good resulted in the following Social Welfare Change:

$$(3.1) \quad \Delta\text{Social Welfare} = \Delta\text{Consumer Surplus} + \Delta\text{Producer Surplus} - \text{Deadweight Loss}$$

$$= (-\text{ area A2}) + (-\text{ area B1}) - (\text{area D}) < 0$$

The introduction of a subsidy involves social welfare loss as a result of economic distortions and misallocation of resources from their 'best use' as determined in a market equilibrium without subsidy.

2. Consumer & Producer Surplus – Impact of Shift of the Supply Curve

It is now necessary to assess the social welfare consequences of a shift of the Supply curve in terms of the impact on market equilibrium. This is shown in Figure A-2. In Figure A-2, it is assumed that some change in the structure of the market results in a downward shift in the supply curve from S_0 to S_1.

A downward shift in the Supply curve could result from improvement in technology, reduction of regulatory impediments to efficiency or some other cause. The result is that at any quantity to be supplied in the market the marginal cost (per unit) of production is lower, so that S_1 lies below S_0. As the market can now (i.e. after the shift to supply curve S_1) be supplied more efficiently, a resulting social welfare gain is expected.

First the outcome of a market with Supply curve S_0 is examined; then any changes are observed when the market is supplied by the more efficient (lower marginal cost) Supply curve S_1.

Equilibrium – Supply Curve S_0 (Figure A-2) – Higher Marginal Cost

The market equilibrium is found at the intersection of the Supply curve S_0 and the Demand curve D_0 at point 1 and involves price p^1 and quantity supplied and bought q^1.

As there are more horizontal and vertical lines and points of reference in Figure A-2, some of the areas that were defined in Figure 1 have been broken up into components so that the labelling format for distinct areas of the graphic are more complicated. The relationship between areas is shown in Figure A-2 (versus corresponding areas in Figure A-1) using suffix numbers.

Total market revenue is $p^1 * q^1$ and is equal to the sum of areas (B1.1+B1.2) + (B2.1+B2.2+B2.3) + B3 in Figure 2 (i.e. corresponding to the sum of areas B1+B2+B3 in Figure A-1).

Consumer Surplus is the area below and to the left of the Demand curve D_0 and above the price line at p^1. This equals the sum of areas A1+A2 (i.e. as in Figure A-1).

Producer Surplus is the area above and to the left of the Supply curve S_0 and below the price line at p^1. This equals the sum of the areas (B1.1+B1.2) (i.e. corresponding to area B1 Figure A-1).

Equilibrium – Supply Curve S_1 (Figure A-2) – Lower Marginal Cost

The market equilibrium is found at the intersection of the Supply curve S_1 and the Demand curve D_0 at point 3 and involves price p^3 and quantity supplied and bought q^3.

As marginal cost (per unit produced) is lower along Supply curve S_1 than for Supply curve S_2 the market equilibrium price has fallen (i.e. $p^1 > p^3$) and with the downward sloping Demand curve D_0 the quantity supplied and bought has increased (i.e. $q^3 > q^1$).

Total market revenue is $p^3 * q^3$ and is equal to the sum of areas (B1.2 + B2.2 + C1.2 + B2.3 + C1.3 + B3 + C2.1) in Figure A-2.

Consumer Surplus is the area below and to the left of the Demand curve D_0 and above the price line at p^3. This equals the sum of areas (A1 + A2 + B1.1 + B2.1 + C1.1) in Figure A-2.

Producer Surplus is the area above and to the left of the Supply curve S_1 and below the price line at p^3. This equals the sum of the areas (B1.2+B2.2+C1.2) in Figure A-2.

Figure A-2 – Consumer & Producer Surplus
Market with Subsidy

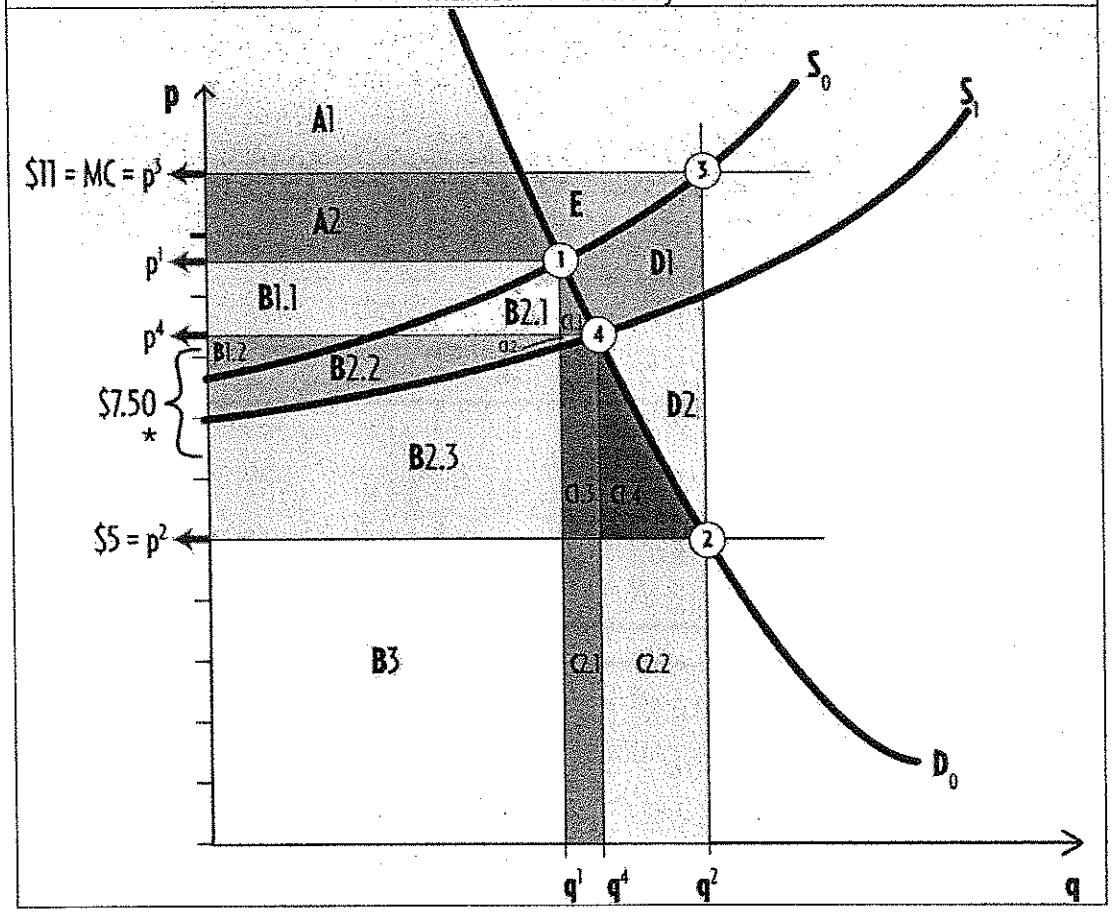


Table A-2 summarizes the impacts on price, quantity and this study's welfare measures of Consumer Surplus and Producer Surplus. As there is no subsidy involved in the shift in Supply curves there is no Deadweight Loss issue.

Table A-2 - Consumer Surplus, Producer Surplus & Deadweight Loss In a Market with a Shift of the Supply Curve (Figure 2) Showing Various Results With Supply Curve S_0 and S_1 (lower cost)		
Variable	Supply S_0 (higher cost)	Supply S_1 (lower cost)
Price to Seller	p^1	p^3
Price to Buyer	p^1	p^3
Subsidy (per unit)	zero	zero
Equilibrium Quantity	q^1	q^3
Value of Subsidy or Value of Transfer	zero	zero
Consumer Surplus	sum of area A1+A2	sum of area A1+A2+B1.1+B2.1+C1.1
Producer Surplus	sum of area B1.1+B1.2	sum of area B1.2+B2.2+C1.2
Deadweight Loss	zero	zero

As can be seen in Table A-2, the value of Consumer Surplus has increased as a result of the shift to a lower marginal cost Supply curve. The change in Consumer Surplus is larger by the sum of the areas B1.1+B2.1+C1.1 in Figure A-2. In deriving the change in Consumer Surplus, the net difference between the two situations was assessed.

For the purposes of ascertaining the change in Producer Surplus, this study will not look at the net difference between the two situations. It is widely accepted in economics (since Schumpeter and the concept of creative destruction) that technological advances create losers and that society is still better off as a result of improvements in technology. Therefore, from the perspective of social welfare change, the elimination of the original Producer Surplus (associated with Supply curve S_0) is not a social welfare loss. The study therefore does not take the difference between in Producer Surplus as the measure of social welfare gain. The measure of social welfare gain is the Producer Surplus associated with the more efficient (lower marginal cost) Supply curve S_1. The Producer Surplus is the sum of the areas B1.2+B2.2+C1.2 in Figure A-2.

The meaningful changes in terms of a CBA measure of social welfare, involve the Producer Surplus (areas B1.2+B2.2+C1.2) and the gain in Consumer Surplus (areas B1.1+B2.1+C1.1). As all these involve a gain of social welfare, it suggests that the shift in Supply curve resulting from more efficient production in the market for this good resulted in the following Social Welfare Change:

$$(3.2) \quad \Delta\text{Social Welfare} = \Delta\text{Consumer Surplus} + \text{Producer Surplus}$$

$$= (\text{areas B1.1+B2.1+C1.1}) + (\text{areas B1.2+B2.2+C1.2}) > 0$$

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3. Consumer & Producer Surplus – Combined Effect

To look at the combined effect of the elimination of a subsidy and a shift in Supply curve involving more efficient (lower marginal cost) production, it is necessary to combine (i.e. sum) the two effects that considered above. These can all be seen in Figure A-2 provided that accommodation is made to the break-up of areas into components in the transition from Figure A-1 to Figure A-2.

Table A-3 summarizes the impacts on price, quantity and the welfare measures of Consumer Surplus, Producer Surplus and Deadweight Loss. This combined the results from Tables A-1 and A-2 above.

Table A-3 - Consumer Surplus, Producer Surplus & Deadweight Loss
Combined Effect of a) Elimination of Subsidy and b) More Efficient Supply

Variable	Subsidy Supply S_0	No Subsidy Supply S_0	Lower Cost Supply S_1
Price to Seller	p^3	p^1	p^3
Price to Buyer	p^2	p^1	p^3
Subsidy (per unit)	$s = p^3 - p^2 > 0$	zero	zero
Equilibrium Quantity	q^2	q^1	q^3
Value of Subsidy or Value of Transfer	sum of area A2+E+B1.1+B1.2 +B2.1+B2.2+B2.3 +C1.1+C1.2+C1.3+C1.4 +D1+D2	zero	zero
Consumer Surplus	area A1	sum of area A1+A2	sum of area A1+A2+B1.1+B2.1+C1.1
Producer Surplus	zero	sum of area B1.1+B1.2	sum of area B1.2+B2.2+C1.2
Deadweight Loss	area D	zero	zero

The social welfare consequences of a move from the subsidy case with Supply curve S_0 to a market equilibrium with Supply curve S_1 is the additive impact of the two equations developed above – to allow the addition the combined effects of a) the move from the subsidized to the non-subsidized market equilibrium associated with Supply curve S_0 (as captured in equation 1); and b) the move from higher cost Supply curve S_0 to the lower cost Supply curve S_1 (as captured in equation 2).

The meaningful changes in terms of a CBA measure of social welfare are reflected in the following Social Welfare Change:

$$(3.1)\quad \Delta\text{Social Welfare} = -\Delta\text{Social Welfare(1)} + \Delta\text{Social Welfare(2)}$$

$$= (A2+B1.1+B1.2+D1+D2) + (B1.1+B2.1+C1.1+B1.2+B2.2+C1.2)$$

$$= A2 + B1.1 + B1.2 + B2.1 + B2.2 + C1.1 + C1.2 + D1 + D2 > 0$$

Note that the ΔSocial Welfare(1) is measured for the introduction of the subsidy so the effect of removal of the subsidy is the negative of this value. Also note that there is no 'double-counting' the same area twice if it appears as a benefit for both the removal of the subsidy and the more efficient Supply curve.

In terms of trying to understand the net social welfare gain it is useful to break this up into three components along the lines of equation 1 above:

(3.2) ΔSocial Welfare = ΔConsumer Surplus + ΔProducer Surplus + ΔDeadweight Loss

= (A2+B1.1+B2.1+C1.1) + (B1.2+B2.2+C1.2) + (D1+D2)

This simply rearranges the results from equation 3.1.

The social welfare gain is derived from:

1. The increase in Consumer Surplus as a result of increased consumption of the good (relative to the Consumer Surplus associated with point 3 in Figure A-2 involving price p^3);

2. the Producer Surplus at the final position associated with the more efficient Supply curve S_1 at point 4 and price p^4; and

3. the elimination of the Deadweight Loss associated with the subsidy at point 3.

4. **Consumer & Producer Surplus – Estimation**

Generally, in order to operationalize this analysis, it is customary to assume linear forms of the Demand and Supply curves and to estimate the area sizes using geometric relationships. Linear forms mean that all the relevant areas are triangles whose area is ½ the value of the corresponding rectangle.

5. **Possible Responses of User Demand and Consumer Surplus to a More Competitive and Innovative Industry**

The following diagram uses comparative statics analysis in order to illustrate how user demand and consumer surplus could increase in the future through the combined effects of the dynamic factors discussed in section 5.5.3 of the Qualitative Discussion. The demand curve moves outward to the right from D1 in black to D2 in red because the consumer/user of marihuana for medical purposes is willing to pay more for a higher quality and more innovative and reliable legal product that is more accessible and has proven its ability to provide health, quality of life and related benefits.

The supply curve moves downward and to the right from S1 in black to S2 in red because of economies of scale and scope, learning effects, internal and external efficiencies, and reductions in fixed/compliance and variable/administrative regulatory costs.

The combined effects of the changes in position of the demand and supply curves are: higher quantities supplied, demanded and consumed at a lower actual price, resulting in greater consumer surplus for each and every consumer/user of marihuana for medical purposes (as the market equilibrium moves from P1Q1 in black to P2Q2 in red.

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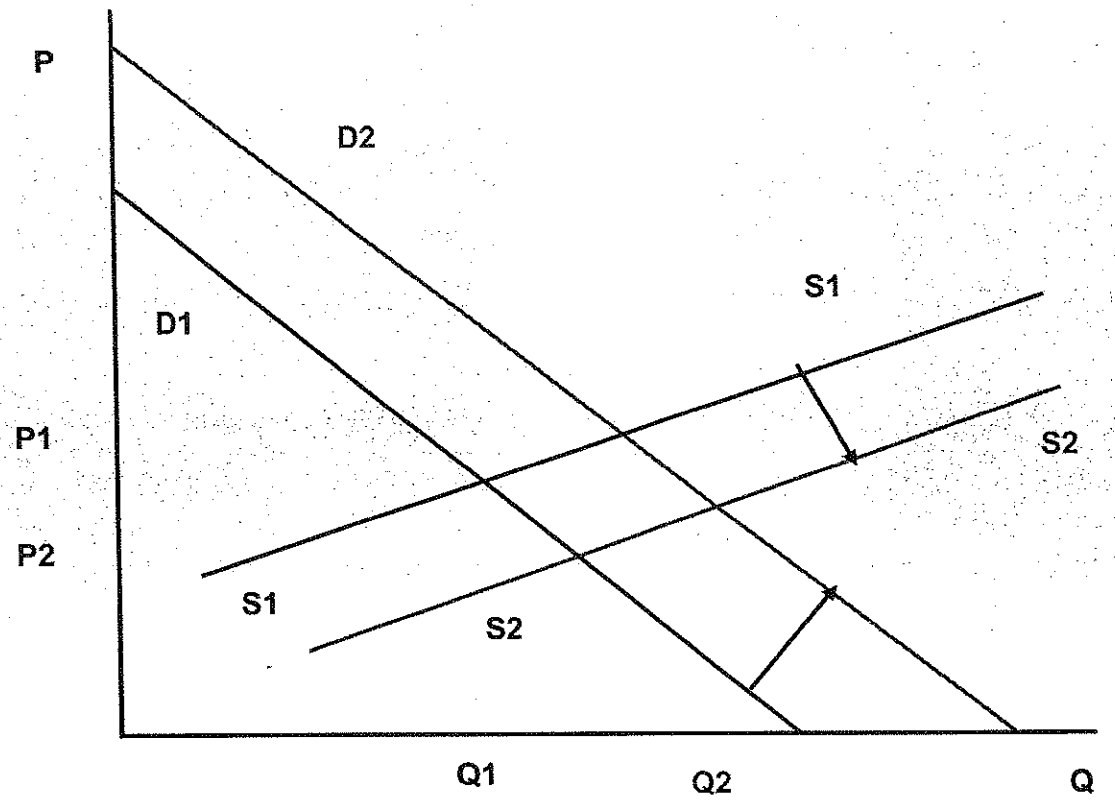


The supply and demand relationships illustrated in the above diagram are fully consistent with the dynamic growth experienced by many new industries and markets that have emerged over the past many decades as a consequence of technological, policy, regulatory, institutional and other transformative and fundamental changes as described in the work of Marshall, Arrow, Romer and the many endogenous growth theorists over the past century.

ANNEX 2 – Response Functions For Key Parameters

It should be noted that this study examines the impact of a 'change of a change', i.e., as the NPV impact is a change (depending on the change of the variable value) of a change (i.e. Total NPV equals NPV-POL minus NPV-SQ).

There are several reasons why the model exhibits non-linearity in several response functions for key parameters:

3. There are two kinds of constraints: a) the 'affordability' condition of expenditures < 15% of mean income; and b) quantity can't fall beyond zero (-100%) for a price elasticity response;

3. There are two avenues for quantity responses from: a) affordability limiting grams per day and b) misuse to reduce the required decrease in Policy users resulting from lower prices; and

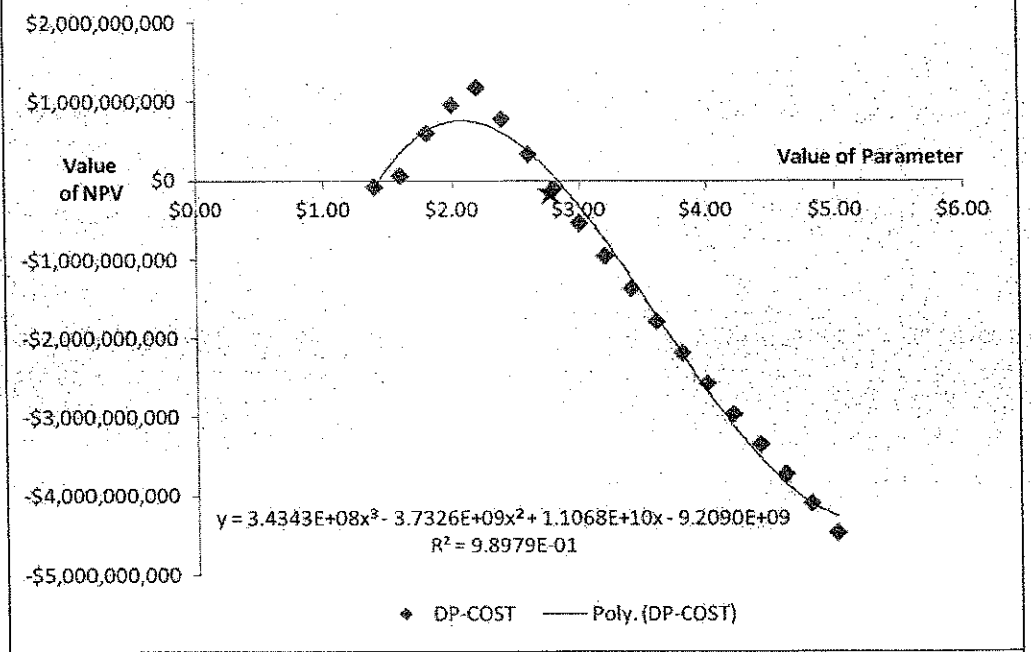
3. There are 'dual' (and opposite effect) uses of the price elasticity of demand to: a) compute the price intercept points which affects Consumer Surplus valuations; and b) affect the transition from the SQ to the Policy scenarios through the User Transition model.

These impacts can be either reinforcing or offsetting.

Designated Person Supply Cost:

The elasticity response to changes in the Designated-Person Supply Cost (DP-COST) is significant. A 1% increase (in the absolute value) of this variable from the Reference Case value of $2.80 (i.e., an increase of $0.028) reduces the NPV by 55% (ε_v=-55.0). The Reference case sits on the negatively sloped portion of the response curve (Figure 5.27).

Figure 5.27 NPV Response Curve: DP-COST



Source: Delsys Research

For most of the response curve ($2.20 < DP_{cost}): there are two reinforcing effects:

- Status Quo scenario: The value of CS-SQ rises with a higher DP_{cost} as a result of a higher price intercept of the Status Quo demand curve, which increases the valuation of consumer surplus in the Status Quo scenario; and

- Policy scenario: The value of CS-POL falls. This effect is caused (at this price level) by the fact that, in the Transition Model, there is no change in the Policy scenario quantity response (as this is dominated by the binding affordability (percentage of income) constraint, which forces the quantity to fall by more than what is required to satisfy the price elasticity effect) while the percentage price change has fallen. This implies that the ELAS-POL is more elastic, so that the price intercept of the Policy demand curve is reduced, which reduces the valuation of consumer surplus in the Policy scenario.

At the middle and high end of the price range, there is no reduction of users in the Policy scenario beyond that from continued misuse, so the overall negative NPV impact (from a DP_{cost} increase) comes from the increase in CS-SQ.

At the low end of the price range, the increase in price requires a quantity reduction that can't be accommodated by the continued misuse, and must be achieved from a reduction in Policy users (transitioning from ATP-D). However, a DP_{cost} increase requires a lesser quantity reduction and therefore results in an increase in the number of Policy users. The CS-POL impact is greater than the CS-SQ impact so there is a positive NPV impact.

Affordability Constraint (Maximum Percent of Mean Income):

The elasticity response to changes in the Maximum Percentage of Income (PC-INCOME) gets at the issue of 'affordability' and how consumers' budget constraints impact on the quantity consumed and the overall value of the resulting consumer surplus in the Policy scenario. A 1% increase of this variable from the Reference Case value of 15% (i.e. an increase of .15 percentage points) increases the NPV by 42% (ε_v=42.0).

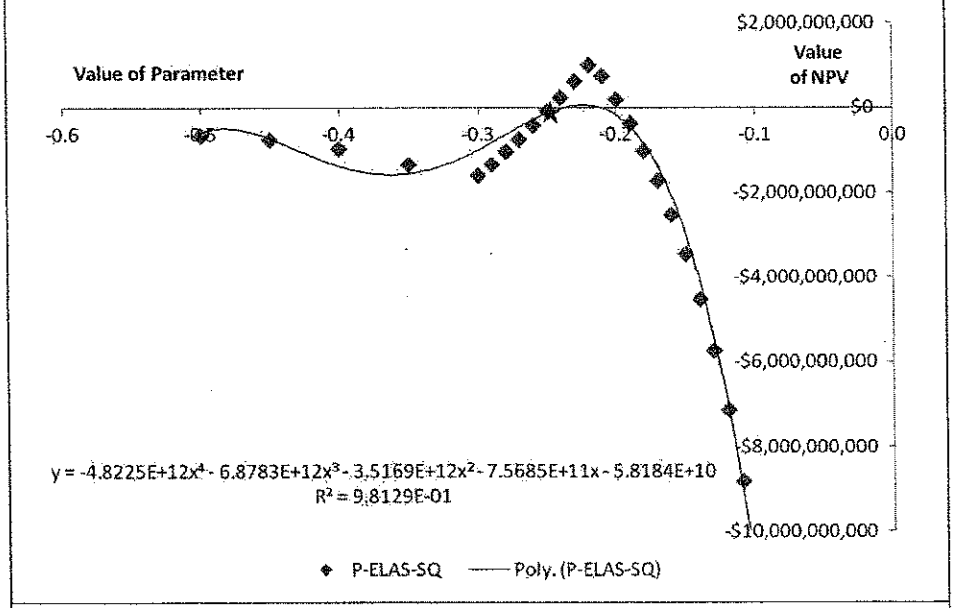
This constraint means that the Grams per Year (and Per Day) will be reduced if the Supply Price increases. In the Policy Transition Model this determines the number of persons who will switch and the level of demand they will exercise in the LP Market.

When the PC-INCOME is lower, this constrains the KG-Demand in the Policy scenario which, despite an increase in the number of Policy Users, reduces the scale of the LP Market and the Consumer Surplus that is generated in the Policy scenario.

Price Elasticity of Demand:

The elasticity response to changes in the Price Elasticity of Demand (P-ELAS-SQ) is significant. A 1% increase (in the absolute value) of this variable from the Reference Case value of -0.25 (i.e. an 'increase' of -.0025, which makes the price elasticity of demand more elastic) reduces the NPV by 23% (ε_v=-23.0). The Reference case sits on a relatively flat position of the response curve (Figure 5.28), where the slope of the response curve is negative.

Figure 5.28 NPV Response Curve: P-ELAS-SQ



Source: Delsys Research

At low (absolute value) levels (-.22 < ε < -.10): The high valuation of CS-SQ overwhelms all other results and generates a high negative NPV, as the inelastic demand generates very high price intercept points for the demand curve in the Status Quo scenario. The same does not occur for the Policy scenario, as the effective price elasticity is more elastic due to the dampening of the pure price elasticity effect caused by the 'opting out' of persons from the

former ATP-P/PUPL, due to misuse. This has the effect of making the Reference case ELAS-POL more elastic (-.35 versus -.25 for P-ELAS-SQ), so that the response in terms of the Policy scenario is muted, relative to the response for the Status Quo scenario. Over this range of values, everything is happening in terms of lower CS-SQ with only minor changes to the number of persons in the Policy scenario - but with no change over this range in the valuation of the CS-POL, as the effective ELAS-POL remains the same (-.31).

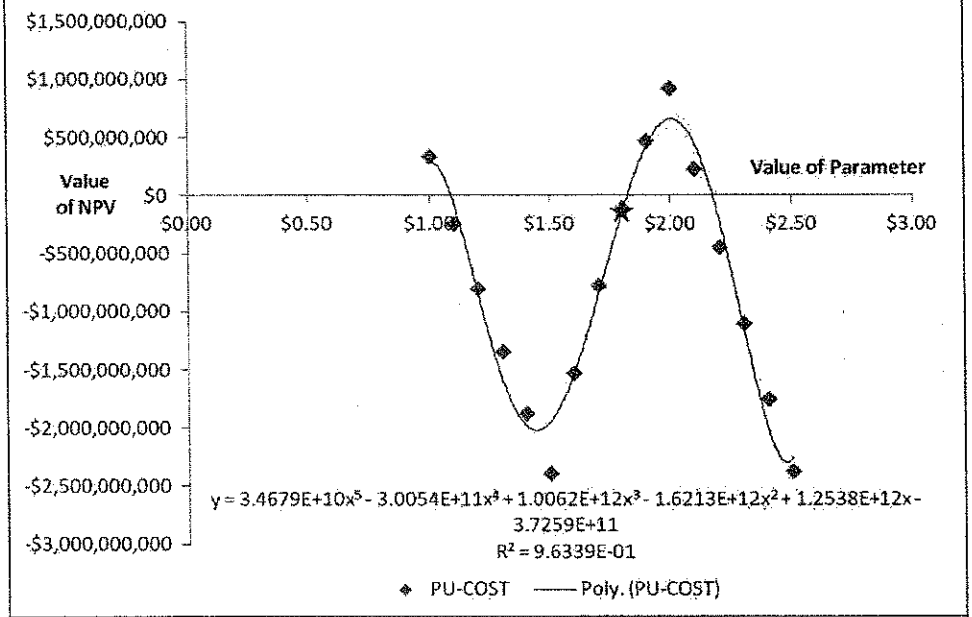
At mid levels (-.32 < ε < -.22): The CS-SQ and CS-POL both fall as the effective price elasticity of demand in the Policy scenario begins to respond to the higher price elasticity in the Status Quo scenario. Over this range of values, the fall in CS-POL is faster than the fall in CS-SQ so that the NPV falls over this range. The Reference case is in this section of the response curve.

At high levels (-.50 < ε < -.32): The fall in CS-POL is slower than the fall in CS-SQ so that the NPV rises over this range.

Personal Use Supply Cost:

The elasticity response to changes in the Designated Person Supply Cost (PU-COST) is significant. A 1% increase (in the absolute value) of this variable from the Reference Case value of $1.80 (i.e., an increase of $0.018) reduces the NPV by 98% (ε_v=-98.0). The Reference case sits on the positively sloped portion of the response curve (Figure 5.29).

Figure 5.29 NPV Response Curve: PU-COST



Source: Delsys Research

There are three distinct cases of response over the range of PU-CCOST.

4.8.1 High Values ($2.00 < PU_{cost}): As PU_{cost} increases there is a gain in CS-SQ, resulting from the higher supply cost and price intercept term in the Status Quo scenario; and a reduction in the price intercept term which leads to a fall in CS-POL, which reinforce the overall effect of a decline in the NPV result.

4.8.2 Mid Values ($1.40 < PU_{cost} < $2.00): As PU_{cost} increases there is a gain in CS-SQ resulting from the higher supply cost and price intercept term in the Status Quo scenario; and a gain in the number of users in the Policy scenario and an increase in the price intercept term which leads to a rise in CS-POL. The change in CS-POL increases at a faster rate than the change in CS-SQ so there is an overall positive slope to the response curve (i.e. the change in CS-POL dominates over the change in CS-SQ).

4.8.3 Low Values (PU_{cost} < $1.40): As PU_{cost} increases in this range, the increase in CS-SQ is reinforced by a decline in CS-POL which leads to the overall decline in the NPV result.

As PU_{cost} increases (at the low end of the range and at the high end of the range) there are reinforcing impacts:

1. an increase in CS-SQ and a reduction in CS-POL which produce the overall negative NPV effect.

As PU_{cost} increases (over the mid range from about $1.50 to $2.00) there are offsetting impacts:

2. an increase in CS-SQ and an increase in CS-POL, with the CS-POL effect dominating which produce the overall positive NPV effect.

It remains to explain why the mid range has different results – which is determined by the change (or lack of change) of the number of Policy scenario users at the high and low ends of the range.

At the high end of the price range, the reduction in quantity resulting from the binding affordability constraint is more than sufficient to achieve the desired price elasticity effect so that there is no loss of users in the Policy scenario beyond that from continued misuse.

At the middle of the price range, there is a need for the number of Policy users to decrease substantially to achieve the desired price elasticity effect. However, as PU_{cost} increases the required change in users is reduced so the impact on Policy users is decreased and this results in the gain in CS-POL.

At the low end of the price range, the reduction in quantity reaches its limit of -100% as Policy users (transitioning from ATP-P) fall to zero. At this extreme point there is no further loss in CS-POL and the reduction in CS-POL comes from the reduced price intercept.

URATE-PU/URATE-DP:

These parameters affect the quantity of marihuana that is estimated to be consumed in the Status Quo scenario. When these values are higher, the quantity of marihuana consumed is higher and the estimated Consumer Surplus (Status Quo) is higher. As the Consumer Surplus (Status Quo) is higher, and there is little impact of these parameters on the Policy scenario, they have a negative impact on the NPV result.

A 1% increase of the URATE-DP from the Reference Case value of 47% (i.e., an increase of .47 percentage points) decreases the NPV by 37% (ε_v=-37.0).

A 1% increase of the URATE-PU from the Reference Case value of 55% (i.e., an increase of .55 percentage points) decreases the NPV by 13% (ε_v=-13.0).

Delsys Research Group Inc. is a consulting company headquartered in Ottawa, Ontario, Canada. It was established as a multi-disciplinary firm, synthesizing the disciplines of law, economics, public administration, Systems Thinking, and Visual Thinking to provide public policy, program administration and regulatory improvement services to public and private sector clients.

www.delsys.ca

This is Exhibit "F" referred to in the affidavit of Zachary Walsh sworn before me at Kelowna, BC this 29th day of Oct 20 14

A commissioner for taking affidavits for British Columbia

(*a*) a statement of the issues addressed in the report;

1. To provide demographics of the patients approved for the medical or therapeutic use of Cannabis (CTP) in Canada, including their characteristics, reasons for use and access;

2. To provide the results of a survey of barriers to access to Cannabis for therapeutic purposes (CTP) in Canada;

3. To assess the impact of the new Marihuana for Medical Purposes Regulations on this patient group.

(*b*) a description of the qualifications of the expert on the issues addressed in the report;

Zach Walsh, PhD, is an Associate Professor of Psychology at UBC, Director of the Centre for the Advancement of Psychological Science and Law, and a registered clinical psychologist. Zach has published more than 40 articles and book chapters on topics related to substance use, personality, and mental health, and his work has been supported by grants and awards from the Canadian Institutes of Health Research, Health Canada, BC Interior Health, the American Psychological Association, and others. He is the principal investigator for several studies of the medical and recreational use of cannabis, including the Cannabis Access for Medical Purposes Study, which is the largest survey to date of medical cannabis users in Canada and the Medical Cannabis - Standards, Engagement, Evaluation and Dissemination which is designed to establish standards for medical cannabis distribution. He has presented his research on the therapeutic use of cannabis internationally, including recent invited presentations to the Government of Uruguay's Department of Health and to the Canadian House of Commons. He also teaches graduate and undergraduate courses at UBC on psychopharmacology, and on the diagnosis and treatment of addictions.

(*c*) the expert's current *curriculum vitae* attached to the report as a schedule;

See Exhibit 'A" to the affidavit.

(*d*) the facts and assumptions on which the opinions in the report are based; in that regard, a letter of instructions, if any, may be attached to the report as a schedule;

1. The authorized and unauthorized use of cannabis for therapeutic purposes (CTP) has increased dramatically in recent years, and physicians have called for further research to better clarify the parameters of effective and appropriate use. Findings from a large cross-sectional study of the use of CTP in Canada

that compared use across medical conditions and across authorized and unauthorized users was relied upon (Exhibit "B" abstract);

2. The "Cannabis Access for Medical Purposes" or "CAMPS" survey, is the largest study to date in Canada of medical cannabis (marihuana) consumers in Canada, externally funded by the UBC Institute for Healthy Living, and Chronic Disease Prevention, reviewed by the UBC Behavioural Research Ethics Board carried out nationally between 2011 and 2012 (Paragraphs 4 and 5 of the affidavit and Exhibit "D" for a Power point summary);

3. "Barriers to access" is defined as "areas of poor fit between clients and services" and used 5 dimensions to examine access to cannabis for therapeutic purposes, namely – *accommodation, accessibility, availability, affordability, and acceptability* (Paragraph 7 of the affidavit);

4. In 2001, the Marihuana Medical Access Regulations (MMAR) came into effect, and the researchers were advised that as of December 2012, there were 28,115 Canadians who had obtained authorization's under these regulations to possess cannabis for therapeutic purposes and to obtain it from a legal source (Paragraph 8 of the affidavit);

5. While the uptake of the federal program increased in recent years, its enrollment still only represents fewer than 5% of the estimated users of cannabis in Canada suggesting numerous barriers to access to be in existence (Paragraph 8 of the affidavit);

6. A 2005 study by the Canadian Aids Society found over a 1/3 of the patients had applied to participate in the federal program, but many of them describe significant barriers to doing so. 86% of the respondents obtained the cannabis from illegal sources, including friends, dispensaries and unauthorized self-cultivation as well as street dealers. Only 8% had licenses to produce their own, and 4% had a designated grower with fewer than 2% purchasing from Health Canada. A more recent survey reported similar low levels of obtaining cannabis from Health Canada and high levels via dispensaries and license self-cultivation. Respondents were generally satisfied with the overall federal program (Paragraph 10 of the affidavit);

7. In addition to authorized sources, medical cannabis dispensaries known as "Compassion clubs" or "Dispensaries" represent a parallel source of cannabis, providing cannabis and related services apparently to over 40,000 patients in Canada, according to the Canadian Association of Medical Cannabis Dispensaries (CAMCD) in 2013. These dispensaries arose in Canada, in 1997 in response to demand and predate the MMAR regulations and are not officially recognized by the regulations, (Paragraph 9 of the affidavit);

8. Many Canadians access cannabis through friends, illicit self-production and the street market (Paragraph 9 of the affidavit);

(e) a summary of the opinions expressed;

1. Across medical conditions respondents reported using cannabis to effectively address diverse symptoms. Results indicate a substantial disconnect between the therapeutic use of cannabis and research on the risks and benefits of such use; particularly with regard to the anxiolytic and sedative use of cannabis. Authorized and unauthorized users exhibited few meaningful differences with regard to medical conditions and patterns of use, but faced substantial differences regarding access (Exhibit "B" abstract).

2. Strategies need to be developed to encourage scientific inquiry into CTP and address the barriers to access to CTP and the stigma and controversy that surround CTP and strain patient – physician relationships (Exhibit "C" abstract).

3. With respect to "Affordability" in relation to access, those in the lowest income groups, have the most difficulty affording their medicine and a large number of this group choose between obtaining their medicine and other necessities with those in the poorest health being the most likely to choose between their medicine and other necessities (Paragraph 6 of the affidavit);

4. It was difficult for Canadians to find a physician to support their application, that access from unauthorized sources were common with only 7% of the patients responding accessing cannabis for therapeutic purpose exclusively from authorized sources and accessibility to such therapy was associated with the presence of medical cannabis dispensaries, even though they were excluded from the regulatory regime. Access also varied by medical condition and general quality of health. Affordability was determined to be the most significant barrier to access and it was recommended that it should be addressed in future programs (Paragraph 7 of the affidavit);

5. According to prior reports (Belle-Isle & Hathaway, 2007) an estimated .5-1 million Canadians or 2-4% of those aged 15 and older reported using cannabis to treat self-defined medical conditions in the previous 12 months (Paragraph 8 of the affidavit);

6. That "affordability" of cannabis for therapeutic purposes remains a significant barrier for many Canadians and especially the most seriously ill. Based on the information with respect to the new *Marihuana for Medical Purposes Regulations* that Canadians who use cannabis for therapeutic purposes will no longer have the cost effective option of producing their own cannabis or designating a producer and that the move to commercial Licenced Producers will increase the price of cannabis as indicated by the government's regulatory impact analysis statement regarding the new *MMPR* (Government of Canada 2012). The background paper in support of the Regulatory Impact Analysis Statement was completed by Delsys Research Group Inc. in December 2012

and is entitled "Cost Benefit Analysis of Regulatory Changes for Access to Marihuana for Medical Purposes". (Paragraph 15 of the affidavit).

7. the government cost benefit analysis makes it clear that a major change under the new program is a projected significant price increase which will therefore significantly impact upon the patients to an even greater degree as indicated in the CAMPS survey and that data resulting therefrom with respect to "affordability" as the most significant barrier to access for the largest group. (Paragraph 16 of the affidavit).

(*f*) in the case of a report that is provided in response to another expert's report, an indication of the points of agreement and of disagreement with the other expert's opinions;

Not applicable

(*g*) the reasons for each opinion expressed;

1. The results of the research disclosed the patients reported using cannabis to treat multiple symptoms, with sleep, pain, and anxiety being the most common. Cannabis was perceived to provide effective symptoms relief across medical conditions. Patterns of use were also consistent across medical conditions. Notable differences were observed with regard to modes of access (Exhibit "B" abstract).

2. The research findings revealed that it was difficult for Canadians to find a physician to support their application to access CTP. Accessing CTP from unauthorized sources was common; only 7% of respondents accessed CTP exclusively from authorized sources. Access to CTP was positively associated with the presence of medical cannabis dispensaries, which were not included in the regulatory regime. Access to CTP varied by medical condition and general quality of health. Affordability of CTP was a substantial barrier to access (Exhibit "C" abstract).

3. The results of the research (Exhibit "C") in relation to the 5 dimensions can be found at – Accommodation (pp.693 – 694); Accessibility (pp. 694 – 695); Availability (pp. 695 - 696); Affordability (pp. 696 – 697); and Acceptability (pp. 697).

4. With respect to "Availability" it was determined that with regard to sources of cannabis almost 1/3 of the respondents reported self-producing of whom 50% were licensed to produce for personal use. Approximately a 1/3 of those who self-produced reported difficulties in learning to produce. Among those who did not self- produce the most prominent reason for not producing was lack of space, expense or legal concerns. However, among self-producers the most important reason for self- producing was quality (39%), price (36%), avoiding the black market (29%), selection of a specific strain of cannabis (24%) and safety (12%). 67% of those who reported having somebody else produce for

them had designated producers license to produce for them under the regulations (paragraph 12 of the affidavit).

5. On the question of "Affordability" it was found that while many applicants were charged a fee by their physicians for the service of having their application completed, it was the actual cost of the cannabis that was the major barrier to access in terms of affordability. The median amount reportedly spent by participants who reported buying cannabis was $200 a month. However, 54% of the respondents reported that they were sometimes or never able to afford to buy sufficient quantity of cannabis to relieve their symptoms and approximately a 1/3 reported that they often or always chose between cannabis and other necessities (e.g. food, rent, other medicines) because of lack of money. The proportions of respondents who reported that they were sometimes or never able to afford sufficient quantity of cannabis differed according to income such that it was most frequently reported by the lower income group (72%) and least frequently by the higher income group (30%). It was found that the frequency of reports of choosing between cannabis therapy and other necessities followed a similar pattern with the highest level amongst lower income people and the lowest level amongst higher income people. Approximately two thirds of those experiencing fair to poor general health were sometimes or never able to afford sufficient cannabis compared to half of those with better health. Those with poorer health were also nearly twice as likely to report choosing between cannabis and other necessities. (Paragraph 13 of the affidavit).

6. It was also found that, on the question of "Affordability", there were further obstacles to optimal cannabis use with over ½ the respondents indicating that financial considerations interfered with their ability to treat symptoms with cannabis. Lower income individuals were the most vulnerable with approximately ½ the participants in the lowest income group reporting having to choose between cannabis and other necessities. Even 1/3 of the highest income group reported difficulties affording cannabis. Affordability appeared to disproportionately impact the most seriously ill patients so the group who reported fair to poor health were twice as likely as healthier patients to report having to choose between cannabis and other necessities. While the lowest income group was the most likely to obtain an Authorization to Possess, it was not the cost of the Authorization but the cost of the cannabis that presented the primary barrier to affordability. Consequently it was concluded that this financial strain across all income barriers demonstrated the need for developing approaches to mitigate financial barriers and integrate cannabis therapy within a subsidized medicine framework. (Paragraph 14 of the affidavit).

(*h*) any literature or other materials specifically relied on in support of the opinions;

Exhibit "B" Walsh, Z., et al. Cannabis for Therapeutic Purposes: Patient Characteristics, access and reasons for use ; International Journal of Drug Policy (2013),http://dx..doi.org/10.1016/j.drugpo.2013.8.010;

Exhibit "C" Cannabis for Therapeutic Purposes – Survey on Barriers to Access to Cannabis for Therapeutic Purposes in Canada (2014) Vol.25. International Journal of Drug Policy 691-699 room;

Exhibit "D" PowerPoint presentation of the research and findings "Cannabis Access for Medical Purposes: Patient Characteristics, Patterns of Use and Barriers to Access";

Exhibit "E" Government of Canada December 2012 – Regulatory Impact Analysis Statement – Delsys Research Group, Inc." Cost Benefit Analysis of Regulatory Changes for Access to Marihuana for Medical Purposes."

Canadian AIDS Society 2005 Study on Access to Cannabis Therapy (paragraph 10 of the affidavit).

(*i*) a summary of the methodology used, including any examinations, tests or other investigations on which the expert has relied, including details of the qualifications of the person who carried them out, and whether a representative of any other party was present;

1. The researchers examined cannabis use history, medical conditions and symptoms, patterns of current use of CTP, modes of access and perceived effectiveness among 628 self-selected Canadian consumers of CTP. Participants were recruited from medical cannabis dispensaries and from organizations that assist users of CTP (Exhibit "B" abstract). The survey collected cross-sectional data f rom self-identified current users of CTP in 2011–2012, both online at the national level and at a local British Columbia medical cannabis dispensary. Organizations and media that serve people who use CTP as well as dispensaries assisted with promoting the national survey (e.g., Canadian AIDS Society, Canadian Aboriginal AIDS Network, social media). No identifying data (i.e. IP addresses) were collected, to ensure confidentiality. Participants in the local group received $10 compensation and participants in the national group were not financially compensated.

2. The analysis drew on the data from the Cannabis Access for Medical Purposes. Survey (CAMPS) and employed a "Health Services" analytical framework to examine "barriers to access" to CTP among 628 CTP users. "Barriers to access" was defined as areas of poor fit between clients and services. 5 dimensions of *accommodation, accessibility, availability, affordability, and acceptability* were used to examine access to CTP (Exhibit "C" abstract).

3. "Affordability" reflected the relationship between the cost of services and products, and the patient's willingness and ability to pay for them. Associations among income costs associated with cannabis for therapeutic purposes, and the ability to access cannabis were used to address this dimension (Paragraph 9 of the affidavit).

4. A literature review was conducted on the barriers to access to Cannabis therapy in Canada.

(*j*) any caveats or qualifications necessary to render the report complete and accurate, including those relating to any insufficiency of data or research and an indication of any matters that fall outside the expert's field of expertise; and

As indicated in Exhibit "C" at page 699, the study has several limitations. The cross-sectional nature does not permit causal inferences that it is possible that unmeasured factors may play an important role in determining access to CTP.

The sample used consisted of mostly male, Caucasian and well educated respondents and the findings may not reflect the situation of other Canadians who use CTP.

An additional limitation may be response biases related to participant self-selection and recruitment through organizations that support people who use CTP. These factors likely resulted in overrepresentation in the sample by individuals who are invested in increasing access to CTP. Conversely, barriers to access to CTP may be greater for those who may not have access to online resources or organizations that support people who use CTP.

The study focused on barriers to access for those who are using CTP and did not delve into the barriers for people who may want to use CTP, but are not able to overcome barriers to access.

In light of these factors replication using a more systematic approach to recruitment is required to conclusively determine the extent to which the CTP users in our sample are representative of the broader community of Canadian CTP users. The use of broad diagnostic categories and a single item measure of global health provide somewhat crude indices of health status.

Although the use of discrete categories and single item measures of health are widely used (Bowling, 2005), future studies that employ more fine-grained assessments might provide additional valuable information.

These limitations are balanced by several strengths, including a relatively large national sample that tapped into both authorized and unauthorized CTP users across diverse medical conditions and health statuses. The engagement of both community and academic experts in the construction and dissemination of the survey is a further strength of the study, as it increases the breadth, relevance and validity of the queries.

More broadly, the examination of issues related to access to CTP was guided by a theoretically informed analytical framework, which added to the confidence of the researchers regarding the dimensions that are central to access to health services.

(*k*) particulars of any aspect of the expert's relationship with a party to the proceeding or the subject matter of his or her proposed evidence that might affect his or her duty to the Court.

None