

Section I. Organization

1. Provide a brief description of Respondent’s main services

BOTEC is a research and consulting firm specializing in criminal justice, illicit markets, and drug policy. For more than thirty years, we helped policymakers identify their central objectives and find the least costly and most effective means toward those ends. In a competitive process, BOTEC was chosen to provide policy advice to the Washington State Liquor Control Board as it transitioned into the Washington State Liquor and Cannabis Board. Other clients include two foreign national governments: Jamaica’s Marijuana Licensing Authority and Health Canada and a range state and local governments, non-profits, commercial organizations and Federally-recognized Indian tribe.

Our services include: policy design, market analysis, performance evaluation, technical training and assistance, implementation management, process fidelity monitoring, data gathering and analysis, economic impact estimates, environmental impact estimates, GIS- based spatial analysis and modeling.

2. Provide a brief description of years in business and relevant team bios

BOTEC Analysis (‘BOTEC’) was founded in Cambridge, Massachusetts in 1985 Mark A. R. Kleiman, who remains as Chairman while also serving as Professor of Public Policy at New York University. Other BOTEC affiliates have appointments at Carnegie Mellon, Stanford, UCLA, Pepperdine, and RAND.

Mark A.R. Kleiman (Ph.D. Public Policy, Harvard University) is the chairman of BOTEC Analysis and a world-renowned expert in crime reduction, justice, and drug policy. In addition to his work with BOTEC, Dr. Kleiman is a Professor of Public Policy and the Director of the Crime & Justice program of New York University’s Marron Institute, a member of the Committee on Law and Justice of the National Academies of Science, Engineering, and Medicine, and co-editor of the *Journal of Drug Policy Analysis*. Dr. Kleiman attended Haverford College, graduating with a B.A. Economics (honors), Philosophy (honors), and Political Science (high honors). For his graduate education, he attended John F. Kennedy School of Government at Harvard University, earning an M.P.P. in Public Policy in 1974 and a Ph.D. in Public Policy (with a dissertation on cannabis control policy) in 1983. For 19 years, he served as a Professor of Public Policy at UCLA’s Luskin School of Public Affairs. Previously, he taught at Harvard’s John F. Kennedy School of Government, served as a Visiting Professor at the University of Virginia

Batten School, and was the first Thomas C. Schelling Professor at the University of Maryland. Kleiman was a legislative aide to Congressman Les Aspin (1974-1975) and a special assistant to Polaroid CEO Edwin Land (1975-1976). From 1977 to 1979, he was Deputy Director for Management and Director of Program Analysis for the Office of Management and Budget of the City of Boston. Between 1979 and 1983, Kleiman worked for the Office of Policy and Management Analysis in the Criminal Division of the U.S. Department of Justice, and served as Director of that office from 1982-1983. Dr. Kleiman's recent subject areas include methods for accommodating imperfect rational decision-making in policy, designing deterrent regimes that take advantage of positive-feedback effects, and the substitution of swiftness and predictability for severity in the criminal justice system. He is the author or co-author of five books, including: *Against Excess: Drug Policy for Results*; *When Brute Force Fails: How to Have Less Crime and Less Punishment*; and *Marijuana Legalization: What Everyone Needs to Know*.

Brad Rowe (M.P.P., UCLA) is the Chief Executive Officer of BOTEC Analysis and was recently appointed as a lecturer at UCLA Luskin School of Public Affairs where he teaches courses on crime control and drug policy. Mr. Rowe also served as the founding Executive Director of the Crime and Justice program of the Marron Institute of Urban Management at New York University and coordinated the production of NYU's National Cannabis Science and Policy Summit. The Summit represented an attempt to get past the sloganeering on both sides of the legalization debate and address the serious questions of how to eliminate the illicit market and make cannabis available for responsible use without further increasing the prevalence of problem use or the initiation rate among teenagers. Mr. Rowe was brought in as an independent expert when the Arizona Citizens Initiative Review debated that states cannabis-legalization initiative. Rowe co-authored *Estimating the Size of the Medical Cannabis Market in Washington State* for the Washington State Liquor and Cannabis Board in 2015; *Reducing drug violence in Mexico: Options for implementing targeted enforcement* for the U.S. Department of Justice; and *Developing a Violence-Reducing Drug Enforcement Strategy for Colombia* for the DEA - responsible for a measurable reduction in homicides after the recommendations in the report were implemented. As an MPP student at UCLA, he was awarded the Ann C. Rosenfield Fellowship to work with the United Way of Greater Los Angeles on poverty alleviation and educational attainment for at risk youth

Jonathan Caulkins (Ph.D. Operations Research, MIT)

Jonathan Caulkins has been on the faculty of Carnegie Mellon University's Heinz College since 1990, with leaves of absence to be co-director of RAND's Drug Policy Research Center in Santa Monica (1994-1996), to found RAND's Pittsburgh Office (1999-2001), and to teach at Carnegie Mellon's campus in Doha, Qatar (2005-present). At Heinz he was director of the Masters of

Science in Public Policy and Management (MSPPM) program and served as interim Associate Dean for Faculty. He did his undergraduate work in engineering and computer science at Washington University in St. Louis. He earned masters degrees in Systems Science and Mathematics (Washington University, 1987) and Electrical Engineering and Computer Science (MIT, 1989) and a Ph.D. in Operations Research (MIT, 1990).

Caulkins serves or has served on the editorial board of Management Science, Operations Research, Mathematical and Computer Modelling, the Journal of Drug Issues, Socio-Economic Planning Sciences, and I/S: A Journal of Law and Policy for the Information Society, and has refereed for over 50 different journals. He chairs the Office of National Drug Control Policy's Data, Research, and Evaluation Committee and is a scientific advisor for Australia's Drug Policy Modeling Project, PIRE's Prevention Research Center, the Allegheny County Jail Collaborative, and the Partnership for a Drug Free America Social Marketing Advisory Board. Caulkins is currently a trustee of Thiel College and is a past board member of The William J. Copeland Fund, Elmer J. Tropman Nonprofit Management Institute, Forbes Funds, and the Pittsburgh Technology Council. He currently serves on the Institute of Medicine's Committee on Reducing Tobacco Use and was formerly a member of the National Research Council Committee on Immunotherapies and New Treatments for Addiction.

The Robert Wood Johnson Foundation recently selected Caulkins for one of its prestigious National Health Investigator awards. Caulkins won the Association for Public Policy Analysis and Management's David R. Kershaw Award for distinguished contributions to the field of public policy and management (1999). The National Science Foundation awarded him both a graduate fellowship and a national young investigator award. Past awards also include Pittsburgh's Forty Under 40 award and the Heinz School's Martcia Wade teaching award.

Caulkins' primary research interest is modeling the effectiveness of interventions related to drugs, crime, violence, delinquency, and prevention. Seeking to understand how policy ought to vary over the course of a drug or other public health epidemic led to a second research area: applications of optimal dynamic control theory to such diverse domains as fashion, counter-terror, and housing policy. Caulkins also does some work on management questions related to software quality and performance evaluation.

Caulkins has taught decision making, mathematical, and spreadsheet modeling to students at the Heinz School (masters students in public policy, healthcare policy, information systems, and network security) and elsewhere (undergraduates in mathematics at the Vienna Technical University, business and computer science students at Carnegie Mellon's Qatar campus, and PhD students at the RAND Graduate School), as well as executive education for Carnegie Mellon (Decision Making Under Uncertainty) and Harvard (Crime and Drug Policy).

Rosalie Pacula (Ph.D. economics, Duke)

Rosalie Liccardo Pacula is a senior economist at the RAND Corporation and a professor at the Pardee RAND Graduate School. She serves as Director of RAND's BING Center for Health Economics and is co-director of the RAND's Drug Policy Research Center. Her research at RAND over the last 15 years has largely focused on issues related to illegal or imperfect markets such as health care, insurance, illicit drugs, and counterfeit goods. Studies and policy analysis measure the size of these imperfect markets, as well as the impact they have on law enforcement and legitimate businesses. Research focuses on demand and supply of illegal substances used for recreational purposes and collateral harms associated with them such as health consequences and crime. She has done extensive work on marijuana markets, including a book published by Cambridge University Press in 2003 entitled "Cannabis Use and Dependence: Public Health and Public Policy". Currently funded projects evaluate the impact of medical marijuana policies on the consumption of recreational marijuana, modeling prescription drug abuse and treatment in the military, and an examination of barriers to pharmacotherapies for heroin addiction. Pacula has been a member of the National Bureau of Economic Research (NBER) since 1997: Health Economics, the Children Program, and Economics and Crime. She has served as a regular scientific reviewer for the National Institutes of Health, National Science Foundation, and numerous foundations. She is a frequent advisor to the Office of National Drug Control Policy and the European Commission on issues related to substance abuse, addiction, the drug-crime connection, and drug markets. She currently serves on the Coordinating Committee of the International Society for the Study of Drug Policy (ISSDP) and on a standing committee of the American Society for Health Economics (ASHE). She is on the editorial board of the International Journal of Drug Policy and the Journal of Drug Policy Analysis, as well as an Assistant Editor for the international drug journal, Addiction. Pacula received her Ph.D. in economics from Duke University.

Randy Simmons (B.S., St. Martin's College) was appointed as the Senior Assistant Director of Administrative Services for the Washington Department of Revenue on September 1, 2015. His duties at DOR include Finance, Information Technology and Human Resources.

Prior to his current appointment, he was with the Washington State Liquor Control Board since March of 2002 when he was appointed as the Director of the Finance Division. In 2005, the Finance and IT divisions were combined into the Administrative Services Division under his leadership. In 2006 Randy received the Governor's Award for Leadership in Management for implementation of risk management practices that reduced over \$400,000 a biennium in cost to the agency. In July of 2013, Randy was named Deputy Director of the WSLCB.

Mr. Simmons was appointed in March 2002, after serving 18 months in a management position at Washington State Department of General Administration. In December 2012, he was appointed as the project implementation manager of I-502, the initiative to legalize adult use recreational marijuana. As the head of this project, he led 11 teams in development of the legal

marijuana marketplace, requirements for growers, processors and retailers and creation of rules dealing with licensing and enforcement of all aspects of the marijuana marketplace. In November 2013 Randy was named one of the year's most influential people by Seattle Magazine.

Randy's educational background includes a Bachelor's of Science Degree in Accounting from St. Martin's College and post-graduate work in Management Science at The American College and the school of Executive Development at Babson College. He holds the following professional designations, CLU, FLMI, and LLIF.

Jill Lamoureux (M.B.A., University of Denver) is a nationally recognized expert on cannabis regulation and policy. She serves as the CEO of Pure O&M, an operations and management company for licensees and SprkLabs, a start-up focused on validated studies for cannabis consumer goods and business to business equipment. In 2010, Jill served on medical marijuana work groups for the Colorado Department of Public Health and Marijuana Enforcement Division where she played an active role in drafting the first compilation of state-mandated industry, physician, patient, and caregiver regulations in the nation. She was the only industry representative to serve on both regulatory committees. In 2012, Jill served on the City of Denver's marijuana committee. In February 2015, she served as CannLabs, Inc.'s representative on a rare negotiated rulemaking committee in Florida to revise legally challenged rules for the State's first low-THC regulatory program. The draft rules produced by the committee survived legal challenges and are currently in effect. Jill also assisted the Washington State Liquor Control Board in 2013 developing the State's first set of recreational cannabis regulations, joining RAND researchers and fellows as a member of the BOTEC Analysis team. She stills serves as a subject matter expert to BOTEC, most recently providing regulatory input to the Commonwealth of Jamaica.

Americans for Safe Access, a national non-profit patient advocacy and scientific research group, engaged Jill in 2012 to develop the PFC third-party audit and certification program for cannabis operations (based on NSF, ISO, and USDA certification programs). She currently serves as the Program Chair. Jill is also a key member the American Herbal Products Association's (AHPA) Cannabis Committee which develops policy recommendations for regulators. The AHPA recommendations have been adopted in several states and continue to gain acceptance nationally as the standards of best practice for the industry. She consults on regulations and operating standards for clients including businesses, legislators, and regulators. Jill also provides financial, market, and regulatory expertise to operators and investors in Colorado, Illinois, Maryland, Nevada, New York, and Washington. She also serves as a mentor for Boulder Canopy, a cannabis business incubator in Boulder, Colorado and also put a new company through the program as a participant herself.

A leader in the cannabis industry since 2008, Jill owned and operated four dispensaries, three cultivation facilities, and one commercial kitchen in Colorado until 2012. She coordinated the process for a number of businesses to receive their state and local licenses in Colorado's first effort to convert unregulated cannabis businesses to licensed operators. Jill also provided advisory and regulatory drafting services to all three of Colorado's cannabis business trade associations in 2012 and is a founding member and the former Chairperson of the National Cannabis Industry Association.

Jill previously worked in state government and toll road administration, developing specialized knowledge necessary for developing policies and procedures in highly regulated environments. This experience allowed her to gain an understanding and deep appreciation for the challenges that come with managing complex application processes and operating a cannabis business in newly regulated spaces.

Jonathan Kulick (Ph.D., Mechanical Engineering, Stanford)

Jonathan Kulick is a senior research fellow at the Marron Institute of Urban Management at NYU. He has two decades of experience in policy analysis, in a wide range of fields. At NYU, he manages research and technical assistance in criminal justice and social policy. Prior to joining NYU, he was a research manager at Pepperdine University, an advisor to the Government of Georgia, director of a think tank in Georgia, a policy analyst at RAND, and a research scientist at IBM. He has an M.Phil. in policy analysis from the RAND Graduate School, and a Ph.D. in mechanical engineering from Stanford.

James Prieger (PhD, Economics, UC Berkeley)

James E. Prieger is a Professor of Economics and Public Policy at the Pepperdine University School of Public Policy. He is an economist specializing in regulatory economics, illicit markets, applied econometrics, and industrial organization. He has written numerous articles for scholarly journals on illicit tobacco markets, state and local taxation of communications providers in California, broadband Internet access deployment and the digital divide, the impact of regulation on innovation, industry dynamics of entry and exit, and other topics. Dr. Prieger spent a year in 2008-2009 as Senior Economist with the Federal Communications Commission, advising on broadband and telecom merger policy. He has consulted for major companies in multiple industries on regulatory issues and presented at panels convened by the FCC. He holds degrees from Yale University (BA, Magna Cum Laude, Economics and Mathematics) and UC Berkeley

(PhD, Economics). He previously taught at the University of California, Davis (1999-2006) and the Goldman School of Public Policy at UC Berkeley (2013).

Steven Davenport (Ph.D. candidate, Pardee RAND Graduate School; M.S. Public Policy and Management, Carnegie Mellon University) is a consultant at BOTEC Analysis. Mr. Davenport served as project manager for BOTEC’s two major projects advising jurisdictions on medical and recreational marijuana regulations: First, for the Washington State Liquor and marijuana Board regarding the implementation of Initiative 502, which legalized and regulated marijuana for non-medical purposes. Second, for the Government of Jamaica’s Ministry of Industry, Investment, and Commerce (MIIC) as they sought to write regulations for Jamaica’s new medical marijuana regime authorized by the Dangerous Drug (Amendment) Act. Mr. Davenport recently contributed to the National Academy of Science’s report “The Health Effects of Cannabis and Cannabinoids” and the United Nations Office of Drugs and Crime’s World Drug report. He serves as a reviewer for the Journal of Drug Issues, where he has published in addition to the International Journal of Drug Policy, Journal of Drug Policy Analysis, and the Case Western Law Review.

Bryce Pardo (PhD Candidate, Public Policy, University of Maryland)

Mr. Pardo has recently joined BOTEC Analysis in its first major international project, advising the Government of Jamaica in drafting regulations to govern a new medical cannabis industry. His international work experience and knowledge gives him unique insight into transnational drug trafficking, international drug control, and comparative drug laws. Mr. Pardo served five years as an official at the Inter-American Drug Abuse Control Commission (CICAD) within the Organization of American States (OAS). During this time he contributed to and edited the OAS Report on the Drug Problem in the Americas (2013). He has also worked with other multi-lateral institutions, including the Pan American Health Organization and independent institutions associated with the United Nations Office on Drugs and Crime. Mr. Pardo has published in the International Journal of Drug Policy. He holds a B.A. in international affairs and an M.A. in Latin American and Hemispheric Studies from the Elliott School of International Studies at the George Washington University. Beginning in the fall of 2014 he started his doctoral studies in public policy under Dr. Peter Reuter at the University of Maryland College Park.

Rob MacCoun (PhD, Michigan State University)

Dr. Rob MacCoun is a professor of law at Stanford Law School. For over 20 years Dr. MacCoun taught at the University California of Berkeley, both at the School of Law as well as the Goldman School of Public Policy. From 1986 to 1993 he was a behavioral scientist at The RAND Corporation and he has been a Visiting Professor at Princeton's Woodrow Wilson School. He has published many studies on illicit drug use and drug dealing, harm reduction, and social influence processes.

Peter Reuter (PhD, Economics, Yale)

Peter Reuter is Professor in the School of Public Policy and in the Department of Criminology at the University of Maryland. He is Director of the Program on the Economics of Crime and Justice Policy at the University and also Senior Economist at RAND.

From 1981 to 1993 he was a Senior Economist in the Washington office of the RAND Corporation. He founded and directed RAND's Drug Policy Research Center from 1989-1993; the Center is a multi-disciplinary research program begun in 1989 with funding from a number of foundations. His early research focused on the organization of illegal markets and resulted in the publication of *Disorganized Crime: The Economics of the Visible Hand* (MIT Press, 1983), which won the Leslie Wilkins award as most outstanding book of the year in criminology and criminal justice. Since 1985 most of his research has dealt with alternative approaches to controlling drug problems, both in the United States and Western Europe. In recent years he has also been publishing on money laundering control and on the flows of illicit funds from developing nations.

His books include (with Robert MacCoun) *Drug War Heresies: Learning from Other Places, Times and Vices* (Cambridge University Press, 2001, (with Letizia Paoli and Victoria Greenfield) *The World Heroin Market: Can Supply be Cut?* (Oxford University Press, 2009); and with 4 other authors *Cannabis Policy: Moving Beyond Stalemate* (Oxford University Press, 2010) From 1999 to 2004 he was editor of the *Journal of Policy Analysis and Management*. In 2007 he was elected the first president of the International Society for the Study of Drug Policy.

Dr. Reuter was a member of the National Research Council Committee on Law and Justice from 1997-2002 and of the Office of National Drug Control Policy's Committee on Data, Research and Evaluation from 1996-2003. He has served on a number of National Academy of Sciences panel and is currently chairing one dealing with immigration enforcement. He has testified frequently before Congress and has addressed senior policy audiences in many countries, including Australia, Chile, Colombia and Great Britain. He has served as a consultant to

numerous government agencies (including GAO, ONDCP, NIJ, SAMHSA) and to foreign organizations including the European Monitoring Center on Drugs and Drug Abuse, United Nations Drug Control Program and the British Department of Health. Most recently he has been doing research for the World Bank. Dr. Reuter received his PhD in Economics from Yale.

Beau Kilmer (PhD, Public Policy, Harvard University)

Beau Kilmer is a senior policy researcher at the RAND Corporation, where he codirects the RAND Drug Policy Research Center. He is also a professor at the Pardee RAND Graduate School. His research lies at the intersection of public health and public safety, with a special emphasis on substance use, illicit markets, crime, and public policy. Some of his current projects include estimating the size of illegal drug markets, assessing the consequences of alternative marijuana policies, measuring the effect of South Dakota’s 24/7 Sobriety Program on drunk driving and domestic violence outcomes, and evaluating other innovative programs intended to reduce violence. Kilmer’s research has appeared in leading journals such as *Addiction*, *American Journal of Public Health*, *Journal of Quantitative Criminology*, *Proceedings of the National Academy of Sciences*, and his essays have been published by the BBC, *Los Angeles Times*, *New York Times*, *Wall Street Journal*, and *USA Today*. His book on marijuana legalization (co-authored with Jonathan Caulkins, Angela Hawken, and Mark Kleiman) was published by Oxford University Press in 2012. He is regularly interviewed and quoted in national and international media outlets including Al Jazeera, *All Things Considered*, *The Atlantic*, BBC, CNN, *Marketplace*, *NBC Nightly News*, *New York Times*, and *Rolling Stone*. Before earning his doctorate at Harvard University, Kilmer received a Judicial Administration Fellowship that supported his work with the San Francisco Drug Court.

In addition to the above Subject Matter Experts BOTEC maintains a full-time administrative staff with backgrounds in legal and financial services, administration, media and communications, project management, and research. The team has decades of combined experience managing multiple research projects of six and seven figure values in the areas of drug policy, criminal justice, illicit markets, violence disruption, and transportation. Our clients include local, national and international clients including governments, commercial enterprises and 501(c)(3)s.

3. Provide clients you’ve consulted on this or a similar subject

Washington State Liquor Control Board

BOTEC was approached Washington State Liquor Control board to consult and advise the state on how to implement recreational marijuana. BOTEC authored multiple reports for the WSLCB including the following:

Methods for producing and testing extracts and infusions

This paper considers the issue of extracting and infusing cannabinoids from three perspectives:

- (1) best practices for performing the extraction and infusion process;
- (2) feasible methods for detecting inferiorities and/or dangerous residual solvents;
- (3) miscellaneous issues.

Testing cannabis for contaminants

This paper addresses Cannabis quality from the perspective of potential contaminants in the final product. It includes a discussion of pests and pathogens to which Cannabis is vulnerable, and the insecticides, acaricides, fungicides, and other crop protection agents (CPAs) which can serve as preventatives. A comparison is made with tobacco, which stands apart from the regulatory strategies that address food monitoring. The paper also summarizes the current situation with regard to contamination detection for that product; and examines the regulatory environment that addresses tolerances for contaminants in tobacco and other crops to propose policies that will support sustainable and safe Cannabis agriculture.

Testing for psychoactive agents

Not all information about the chemical components of marijuana is equally useful to the consumer. On one hand, there are many ways to measure the chemical content of a package of marijuana, but relatively few of those metrics are relevant to user experience, health, and safety. On the other hand, there are limits to the consumer's attention and psychopharmacological literacy. That concern argues for selectively choosing those chemical measurements required to appear on the retail label. A simple and elegant label gives consumers better chances of noticing, understanding, and reacting appropriately. This paper explores the issues that arise in determining this balance. It draws upon peer-reviewed journals, popular wisdom, and commercial cannabis testing laboratories to address what to test for; how accurate such tests should be; how such tests should be conducted and reported; and how much testing will cost.

Sampling cannabis for analytical purposes

This paper discusses the practice and regulatory implications of sampling cannabis for potency and purity tests. It discusses proper procedures by which a small, representative test sample can be taken from a larger lot of cannabis; discusses the natural levels of heterogeneity in the cannabis plant; and discusses the cost burdens of different sampling regulations, including the size of a lot.

Modeling marijuana businesses and costs of legal compliance

This paper serves to provide the WSLCB with a working understanding of the forces that will drive the taxation system for legal marijuana.

Identifying burdensome regulations

This paper addresses several topics: Reducing tax burdens, Allowing efficient operations, Technical fixes to reduce uncertainty and increase compliance, Reducing opportunities for creative lawyering, and Added consumer and public health protections.

Cannabis testing labs: standards and accreditation

This paper discusses Testing Requirements, Lab Accreditation, Proficiency Testing, and Lab Infrastructure Development.

Economies of scale in the production of cannabis

This paper examines the cost curves of cannabis production for indoor and greenhouse cultivation, with a particular focus on assessing the size of economies of scale.

Preventing artificial adulterants and natural contaminants in cannabis production: best practices

This paper identifies the most common sources of artificial adulterants and natural contaminants in cannabis production. It reviews best practices in monitoring and preventing adulterants and contaminants during the entire product lifecycle, and discuss the feasibility of implementing them, and the methods of monitoring the process to ensure a safe and reliable product.

Assessing the current capacity of the unlicensed testing industry

This report describes the labs' varying operational capacities (tests per day), range of tests offered, operating procedures, and qualifications at the Director level. We also include feedback from the labs on offering their services in a regulated environment.

Estimating adequate licensed square footage for production

This document and associated spreadsheet provide a guide for estimating the cultivation area needed to support a given level of cannabis production. The data is drawn from a review of the relevant literature and from interviews conducted with 16 growers. This report finds that indoor and outdoor yields average about 40 grams per square foot per harvest, but with a considerable range. Yields per square foot per year can be much higher of course, because there can be multiple harvests per year, particularly for indoor production.

Environmental risks and opportunities in cannabis cultivation

This report investigates the environmental impact of marijuana production in Washington, including a discussion of how the energy involved is used and how it affects production costs.

Alternative bases for limiting cannabis production

This report reviews three distinct sets of reasons why production limits may be desirable for legal cannabis: They may (1) reduce the financial incentive for illegal sales out of state; (2) constrain consumption by subpopulations in which unfettered consumption is not desirable and (3) limit the brand, market, and political power of large producers.

How much will the 25/25/25 tax scheme actually impact the price of cannabis?

This paper describes a model of how taxes will affect prices in the legal Washington cannabis market, including a discussion of how tangible production and processing costs will impact the final product cost.

How much revenue could the cannabis tax generate under different scenarios?

This report explores various scenarios concerning potential I-502 tax revenues, per year and in total over a decade.

Jamaican Ministry of Industry, Investment, and Commerce

In April 2015 Jamaica amended the Dangerous Drugs Act (DDA) to decriminalized cannabis possession, legalize home cultivation for medicinal and spiritual and sacramental use, and create a new, licensed industry for medical cannabis and hemp. BOTEC was selected by the Jamaican Ministry of Industry, Investment, and Commerce to provide in-depth consulting services to help them understand the opportunity for recreational cannabis in Jamaica. BOTEC was able to guide the Cannabis Licensing Authority and other relevant agencies and ministries as they conceptualized, discussed, and eventually manifested in law a policy for creating a licensed industry in medical cannabis and industrial hemp. In particular our work focused on modeling revenues from sales and taxes, minimizing youth access to cannabis, international legal compliance, evaluating regulatory capacities of existing authorities including inter-agency coordination, bureaucratic panning and staffing, investigating land rights, water use and zoning, pricing, supply, law-enforcement, licensing, public safety, and impacts on tourism and foreign trade.

Health Canada (Marijuana Policy Group)

BOTEC is currently subcontracting to MPG working with Health Canada to conduct an estimate of the potential Cannabis Market in Canada. BOTECs role involves designing a survey to measure the frequency and methods of cannabis use among Canadians, substances used, purchasing patterns, consumer demographics and behavior, product knowledge and presence of cannabis use disorder.

GiveWell/Good Ventures

BOTEC was the recipient of generous funding from the Washington Office on Latin America in 2013. We produced a range of reports including the following:

[The Kids Aren't Alright, but Older Adults Are: How Medical Marijuana Market Growth Impacts Adult and Adolescent Substance-Related Outcomes \(February 2015\)](#)

This paper examines the effects of Medical Marijuana Laws on adolescent cannabis use using a sensitive measure of MML penetration (per-capita adult medical marijuana registration rates), looking at the relationship between MML and alcohol and opioid-related poisoning deaths for

older adults, traffic fatalities in accidents involving older drivers, cannabis consumption by adolescents, and traffic fatalities and alcohol poisoning mortality.

[Driving While Stoned: Issues and Policy Options \(October 2014\)](#)

This paper examines the difficulty of regulating “stoned driving”, which is a categorically different problem to drunk driving.

[Heavy Marijuana Use in the United States: A Growing Policy Concern \(October 2014\)](#)

This report analyzes heavy marijuana use over the last three decades and compares it to past month marijuana use, isolating the age, period, and cohort effects driving these trends.

[Controlling Underage Access to Legal Cannabis \(August 2014\)](#)

This work examines the complexities inherent to decisions concerning underage access to state-legal cannabis, contrasting the complementary but distinct goals of prevalence reduction, quantity reduction, and harm reduction.

[Is All Medical Marijuana the Same? \(July 2014\)](#)

This paper argues that the causal effect of MMLs on marijuana use has limitations because it does not account for the dynamic effects in medical marijuana demand following MML enactment and does not account for heterogeneity in state MMLs.

[How Not to Make a Hash Out of Cannabis Legalization \(May 2014\)](#)

This paper argues that the federal policy of leaving the states to decide on cannabis legalization exposes the public to a range of avoidable harms.

[A Nudge Toward Temperance \(May 2014\)](#)

This paper discusses the options available to regulators seeking to minimize ‘problem use’ of cannabis.

[Nonprofit Motive \(May 2014\)](#)

This paper asks, “What sorts of organizations do we want to supply that legal marijuana?”, and offers a review of two alternatives to corporate cannabis: The legalization of nonprofit production and sale; and the establishment of Co-ops.

New York University – Cannabis Science and Policy Summit

In addition to client-based consulting activities, BOTEC Analysis is committed to contributing to public and academic discourse. In 2016, BOTEC produced the “[Cannabis Science and Policy Summit](#)” (co-hosted by NYU, RAND’s Drug Policy Research Center, and the Institute for the Study of Drug Policy), convening over one hundred of the world’s key marijuana thinkers and practitioners for two days to discuss cannabis science and policy. Topics of discussion included: Non-Medical Product Development and Regulation; Designing Reforms Short of Legalization; First Movers: Uruguay and Jamaica Charting New Paths; Drug Development Regulation & Commerce; Cannabis and Drugged Driving; Consequences of Cannabis Use and Cannabis Markets; What Can Be Learned from The Dutch Coffee Shop System?; Enforcement Before and After State-Level Legalization; Financial Services for the Cannabis Industry; Tax & Pricing; Adulterants: Regulation and Testing; Cannabis Policy Research Agenda; Designing Regimes of Legal Access

Section II. Response to Information Sought

Discuss the “Information Sought” section referenced above in Part II of this RFI. Respondents are also encouraged to share their knowledge and/or insight of the marketplace and of the specific goods and/or services in general for which information is being sought.

Adult-use marijuana retail sales are authorized to begin in Maine on February 1, 2018. The State of Maine must establish the rules governing adult-use marijuana from seed to sale. To inform the rule-making process for this new industry, the State is seeking information from Respondents on the following questions:

1. What public health and public safety challenges should the State anticipate (e.g. intoxicated driving, youth access, organized crime) and how should the State manage or mitigate these negative externalities?

The State of Maine can expect to have additional public health and public safety challenges stemming from the consumption of cannabis as well as the structure of the cannabis industry. The most obvious public health concern are those related to problematic consumption, which includes underage use, heavy use, and use that may result in injury to the user or third parties. These concerns are made more pressing by nationwide cannabis trends, the past 25 years has seen an eight-fold increase in daily-near-daily use of marijuana, with nearly half of those frequent users – about 4 million people nationwide – satisfying the criterion for substance abuse disorder. (Caulkins/Cuellar, 2014). While not typically as severe as dependence or addiction to alcohol, cocaine or opioids, dependence on cannabis can seriously affect personal relationships, work performance, and mental health.¹ These negative effects are primarily concentrated in the heaviest users, so public health and safety officials should track and attempt to limit heavy and chronic use.

Adolescent users of cannabis are particularly susceptible to cannabis' negative effects; studies show that individuals who initiate during adolescence and continue into adulthood have lower employment and social outcomes compared to those that abstain or initiate later in life.² Further, studies show that regulations play a large role in adolescent access; more tightly regulated medical systems see less youth use³. A recent study found that reduced access to cannabis improved academic performance among students at a Dutch university.⁴ Thus, structuring regulations to induce temperate use and limit access by minors should thus be a top priority.

Cannabis use is not problem-free even among moderate, adult cannabis users Use of cannabis often increases risk of accidents (such as motor vehicle accidents or falls). Driving under the influence of cannabis is a particularly difficult problem to tackle as there is currently no widely recognized test for cannabis impairment, test can only reliably determine whether cannabis was recently used. This is further complicated by experts' disagreement about the extent that cannabis intoxication impairs driving ability (estimate range from no impairment to a sixfold increase in the risk of a fatal crash, although the vast majority of studies find roughly a two-fold increase). However, there is widespread agreement that marijuana in combination with alcohol impairs far more than either substance alone. This combination should thus be aggressively

¹ Fergusson, D. M., & Boden, J. M. (2008). Cannabis use and later life outcomes. *Addiction*, 103(6), 969-976.

² Source: Popovici, I., & French, M. T. (2014). Cannabis Use, Employment, and Income: Fixed-effects Analysis of Panel Data. *The Journal of Behavioral Health Services & Research*, 41(2), 185–202. <http://doi.org/10.1007/s11414-013-9349-8>

³ Smart, R. (2015). The kids aren't alright but older adults are just fine: Effects of medical marijuana market growth on substance use and abuse.

⁴ Olivier Marie and Ulf Zölitz (2017) "High" Achievers? Cannabis Access and Academic Performance. *Rev Econ Stud* (2017) 84 (3): 1210-1237.

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targeted through criminalization of driving after recently using cannabis and consuming any amount of alcohol. Regulators, however, should be careful to avoid relying on testing for inert metabolites of cannabis that remain detectable in heavy users for months at a time. If the “cheek swab” test – which can be administered at roadside by police officers - turns out to be a reliable measure of use within the past few hours, that might act as a reasonable proxy for impairment.

Additional public health concerns include use of pesticides and fertilizers which may contaminate final product, presenting substantial health concerns as many of these chemicals may pose substantial risks to consumers and employees. Proper regulations, such as product testing, are necessary to avoid the use of chemicals known to cause cancer or to avoid the distribution of product containing biological or chemical contaminants.

Cannabis use will also influence consumption of other psychoactive substances, which (if properly channeled) can be harnessed to the benefit of public health. Maine should pay close attention to how the availability of marijuana affects rates of opioid overdose and death. There are indications that higher availability is associated with reductions in problem opioid use. Pain management groups like Columbia Cares have found that replacing prescription opioids with medically administered marijuana can reduce consumption of the opioids by over 50%. Full adult recreational availability of marijuana may provide a safety valve for problem opioid users. No “gateway drug” effect has been demonstrated by research, but watching how marijuana use progresses would be a worthwhile area to study for the state.

Cannabis can also influence health – positively or negatively – by decreasing or increasing the use of tobacco and alcohol. Studies have found that young people with greater access to marijuana are also consuming more alcohol, which may cause increased impaired driving and deaths from alcohol overdoses. Older adults, however, fare better and seem to be replacing some of their alcohol use with marijuana use.

It is important to note that there are no recorded fatal overdoses by marijuana, but that does not mean that an overdose especially by infused edible or by dabbing would not create a very unpleasant and scary experience. Further there is an increased chance for young people who are predisposed to schizophrenia to have a psychotic break triggering the disease. These potential negative externalities underscore the importance of crafting regulations that limit adolescent access to marijuana.

Aside from the risks posed by cannabis itself, the cannabis industry also poses public health and safety challenges. To some extent, the legal market will displace the existing illicit market, with resulting public-safety benefits. But there is also a risk that cannabis grown and sold legally in Maine will be illegally “exported” across state lines or across the Canadian border. Tax policy should allow prices to be low enough so as not to support a continuing in-state illicit market, but high enough to discourage any export trade (and limit the growth in heavy use).

Maine shouldn't expect a "peace dividend" in the form of reduced cannabis law enforcement immediately after legalization of recreational cannabis. Enforcement will be necessary both to protect the newly legal market from untaxed illegal competition and to prevent illicit export. It may be necessary to use some cannabis tax revenue to support local law enforcement efforts.

The state's concerns regarding organized crime are not unwarranted; illicit growers operating in plain sight in Colorado suggest that lawbreakers can adapt to changes in the law. That said, Maine isn't Colorado; its law does not allow for unregistered growers to provide cannabis to patients. The principal concern here will be to suppress illegal competition in-state and to reduce diversion of licit product out of state. Apart from cannabis-related crime, cannabis businesses in Maine will likely face concerns stemming from lack of access to banking and electronic fund transfers. Cannabis businesses elsewhere operate largely in cash, which presents substantial public security concerns. Law enforcement will need to be aware and work with businesses to ensure that they are not victims of burglaries, break-ins or robberies as criminals target cash-rich businesses. Establishing a banking system that can handle what has traditionally been a cash business could help to alleviate some of the security concerns that marijuana businesses have to deal with. The state may want to make special accommodations and protections for the support services associated with the cannabis business including legal, testing, and financial services. This will require negotiation with federal banking authorities, which to date have not been accommodating.

The development of cannabis edibles also pose new challenges to regulators as use of these products are associated with cannabis overdose and emergency department episodes.

Of special concern is the variability in concentrations of THC in products and the lack of standardized dosage. A 20oz bottle of infused lemonade can contain 200 mg of ingestible THC, or about 20 intoxicating doses. A naïve user who drank the whole bottle might easily wind up in the emergency department with a panic attack.

From a health and safety standpoint, it is important that consumers in the newly legal market have a better understanding of what they're consuming than has been the case in the illicit market. Testing and labeling requirements can allow consumers to know what's in the material they buy, but the variation among means of administration (smoking, vaping, dabbing, edibles) in bioavailability and in pharmacokinetics (ingestion leads to the production of a highly potent by-product, 11-hydroxy-THC, which is not created by smoking) makes it hard to define a standard "hit" of cannabis in the sense that a standard drink of beer, wine, or spirits each contains about 20 grams of absolute alcohol.

Other public safety concerns may include the at-home production of concentrates with flammable or volatile chemicals. Some of these include the "butane hash oil" process, which extracts the cannabinoids from plant matter using flammable solvents. Jurisdictions in other states have banned the use of these chemicals in at-home use as the production of such products

caused serious and sometimes life-threatening injuries to individuals and third parties. Similarly, Maine may find that certain types of grows, production facilities, or dispensaries may cause public concern with regards to nuisance, odor, or crime problems.

The State should begin by measuring the baseline for these areas of concern before full implementation takes place, or as soon after full recreational legalization takes place. The state should also prepare the messaging it wants to get out to youth, the medical community, law enforcement and to general population. The State may also want to measure the size of the market and the tax revenues that will be generated and determine what amount of resources might realistically be dedicated to education, treatment, or other public projects to be funded by tax revenue.

Possession and sale of marijuana is still a Federal offense. All actions taken by the state and regulated by the state should avoid triggering any of the reasons for federal prosecution outlined in the “Cole Memo” of the Department of Justice: diversion to other states and to minors, production on federal reserves, presence of weapons, violence, links to organized criminal activity or terrorism.

2. How should the enforcement body be designed and balanced among the state, county and local law enforcement jurisdictions? Should unique divisions be created to oversee the five license types: cultivators, testing labs, manufacturers, retailers and social clubs? Should the current alcohol enforcement division absorb marijuana enforcement? How can the State recruit and/or train enforcement officers to possess the necessary subject matter expertise to begin enforcement on February 1, 2018?

Most other states that regulate recreational cannabis have chosen to assign the regulatory authority to alcohol regulators. This decision has advantages and disadvantages. These bodies exist with a staff and budgets and have a history of enforcing rules governing the production and distribution of intoxicants. However, cannabis isn't alcohol and the same approach will sometimes not fit.

To avoid conflict and ensure a smooth transition, Maine's regulatory authority will need to share some regulatory responsibility with local authorities. In this case, localities may decide to rigorously zone cannabis establishments, often making it hard for businesses to operate. In other states, businesses have found this disjointed approach cumbersome and problematic. Maine will need to head off any of these conflicts by involving local stakeholders when designing regulations and enforcement capacity. Likewise, local and state law enforcement should work with cannabis regulators to ensure that authorities are familiar with authorized licensees, their staff and place of business.

Division of regulatory portfolios may not be necessary. It depends on the existing capacity of state agencies. For example, the current alcohol regulatory authority may not have the means to properly enforce regulations governing production and processing, though it is keenly aware of

how to regulate distribution and social clubs. Without conducting a stakeholder assessment, BOTEC cannot say at this time what is the preferred regulatory design structure for the state. That said, from other jurisdictions it is clear that regulatory enforcement on testing labs should be impartial and free from the threat of industry capture and collusion. In other states, regulations governing laboratory testing is often the weakest link as some producers have sought out labs that report results in their favor.

Maine can learn from how other jurisdictions recruit and train enforcement agents. In Colorado, this is largely done by the Marijuana Enforcement Division, which includes sworn law enforcement officers. In comparison, Washington has given the Liquor and Cannabis Board the authority to regulate businesses, but regulators are not sworn peace officers. Depending on the goals, Maine may want to adapt a Colorado or Washington model; or develop its own hybrid approach. Given that the regulatory portfolio for recreational cannabis in Maine belongs in different agencies, Department of Agriculture, Conservation and Forestry and Maine Revenue Services, Maine will want to think carefully about the regulatory design as to avoid duplication of personnel, efforts and resources. Nonetheless, training material and guidelines can be developed so as to retrain current law enforcement personnel as well as train new staff.

Enforcement in a legalization regime will shift from being an anti-drug focus to one that is protecting registered businesses and tax revenues. This will shift the culture of law enforcement to one of reduced “drug warrior” zeal. State officers may want to put their efforts into making sure that the tax receipts are being collected and get safely to the capitol. The state will also need to make sure that highway patrol is aware of investigation and enforcement of marijuana trafficking violations to other states.

Highway patrol and other officers in the state will need to understand roadside impairment protocols and what to recognize with impaired driving as there are differences between alcohol and cannabis reductions in coordination and overall faculties. With fully legal marijuana for adults, officers will have to contend with one less source of probable cause for search on traffic stops and home visits. This will result in a more limited ability to search vehicles and domiciles, procedures that may have generated weapons and other contraband of interest in the past. Marijuana is not traditionally associated with violent behavior, so increased use in the state may not cause additional law enforcement burdens. Since voters approved initiative 502 in Washington FBI crime statistics show lower rates of violent crime in Washington than before legalization.

Regulating and taxing marijuana should have the effect of putting black market dealers out of business in short time. However, the state will have to consider the level of enforcement they want to place on putting non-licensed dealers out of business. Cannabis business organizations will surely pressure law enforcement to help put non-licensees out of business out of fairness and to reduce the competition they are experiencing.

Financial transactions will still take place with cash as the mainstream banking system cannot handle Schedule 1 drug proceeds. These businesses can become targets for armed theft and as owners and the security they hire will also have weapons, registration of weapons and monitoring this activity will help with prevention of crime and of investigation if there are unwanted incidences.

Local officials will have to contend with newly written local ordinance about zoning, dispensary licensing, carding young customers to verify age, preventing “shoulder tap” purchases outside of dispensaries, compliance with on-site consumption regulations, use of pesticides and water and power limit laws established by municipalities. Localities can also control the level of consumption by controlling hours of operation with dispensaries and law enforcement will need to monitor compliance. Localities may also want to levy taxes on purchases to offset other costs for registration and regulating local operations, and these taxes will need to be monitored by local officials.

Enforcement divisions dedicated to overseeing specific license types would allow investigators and enforcers to specialize and do a better job at regulating the actions of cultivators, testing labs, manufacturers, retailers and social clubs. Some downsides to this level of specialization is the risk of stove piping where violators that cross descriptions may evade detection at a higher rate than if Maine had a more general enforcement division. This specialization also makes attracting career law enforcement officers more difficult as there is limited room to build a career and advance inside of a subdivided command units.

Hiring to enforce the new marijuana laws in Maine may require reaching a different recruit pool than normally used for law enforcement. These individuals may need a pro-business, pro-public health sensibility and not the traditional drug warrior mentality. They will have to work cooperatively with local and state agencies and be quick learners and state statues and local ordinance may change quickly in the initial years of implementation.

3. How much will retail marijuana sales cost the State in terms of regulation and enforcement (e.g., law enforcement, additional employees, etc.)?

Regulatory design and implementation will add to the state’s budget expenses. It is impossible to say exactly how much it will cost the state before it makes certain decisions. A loosely regulated system with fewer rules may be cheaper in terms of regulatory costs, but may result in higher costs elsewhere. For example, not requiring rigorous testing or labeling may save the state up front in terms of site inspections or product testing; but such a decision may cost the state elsewhere in the form of accidental overdose and excessive intoxication which surely will cost taxpayers in the form of increased emergency room utilization and perhaps intoxicated driving.

The more accurate question here isn't one about budgetary cost, but is: how can Maine minimize market-wide harms while having a minimal impact on the state's budget? That said, from other states, we have learned that recreational cannabis regulation can cost upwards from \$15 million per year (see WSLCB and Colorado reports in footnotes for more detail)⁵. Initial out of pocket costs to the state are necessary to allow for proper regulatory design. In FY 2016, Washington State Liquor and Cannabis Board (WSLCB) Marijuana Licensing Unit processed 1,292 marijuana applications; 525 retail and 767 non-retail (231 retail and 514 non-retail were new licenses) in the areas of producers, processors, and retailers. Total marijuana income for the state was \$189 million from taxes and fees. From these funds, the state made \$179 million in distributions for basic health, cities/counties, education/prevention, research and other miscellaneous items. WSLCB spends slightly over \$30 million per year on licensing, enforcement and general operating expenses for enforcement per year 2015 and 2016. Most of that activity is for alcohol and marijuana enforcement. However, total income during that period increased from \$255 million to \$378 million during that same period largely thanks to a large increase in marijuana revenues. (WSLCB annual reports FYs 2015 and 2016). Over that same period, Colorado's Marijuana Enforcement Division (MED) had total marijuana taxes and fees collected of \$102 million and on expenditures for regulation and enforcement of \$5 million for 2014-15 rising to total marijuana taxes and fees of \$156 million on \$8 million for regulation and enforcement in 2015-2016.

4. How large is the current illicit market for marijuana in Maine and how large is the projected market for legal retail sales in the State?

This question was asked in nearby Vermont⁶ BOTEC senior leadership was involved in estimating the size and scope of that state's illicit cannabis market in 2014. The results concluded that the size of that market was between \$122 and \$213 million. At this time, BOTEC cannot estimate with exact certainty the size and scope of Maine's illicit market without conducting a similar and rigorous market-wide estimate. That said, here we provide our "back of the envelope calculation" based on that estimate in Vermont. Maine's prevalence rates, as reported by national household surveys, are about 7% lower than those found in Vermont. After adjusting for population and prevalence, we estimate that the size of Maine's current illicit market is anywhere between approximately \$227 and \$396 million.⁷

⁵ http://lcb.wa.gov/sites/default/files/publications/annual_report/2016-annual-report-Final-opt.pdf, and <https://www.colorado.gov/pacific/sites/default/files/DOR%20MED%20April%201%202016%20Report%20to%20the%20JBC.pdf>

⁶ Caulkins, Jonathan P., Beau Kilmer, Mark A. R. Kleiman, Robert J. MacCoun, Greg Midgette, Pat Oglesby, Rosalie Liccardo Pacula and Peter H. Reuter. *Considering Marijuana Legalization: Insights for Vermont and Other Jurisdictions*. Santa Monica, CA: RAND Corporation, 2015. https://www.rand.org/pubs/research_reports/RR864.html.

⁷ To do this, we take Vermont's estimate and adjust upwards by two times for Maine's population (which is roughly twice that of Vermont's). We then adjust for prevalence rates. NSDUH's data from 2014/2015 show 13.66% of

Projecting the size of growth for legal sales is difficult, especially without knowing how the state will regulate medical cannabis in the future or the exact details of regulations that will govern the recreational market. In Washington, BOTEC has found that after two years the licit recreational market comprises approximately one third of the overall cannabis market, with medical and illicit each taking a third. Projecting growth depends on many factors, such as the design of regulations that govern both the existing medical market and the future recreational market. If users find it cheaper or easier to stay within existing illicit or medical circles, Maine's recreational market may get off to a rocky start. This was the case in Washington for the first year. That said, we have seen that in other states, revenues and volume of sales continue to increase. In Colorado, sales have increased 177% since the start of sales in January 2014 and Washington's recreational market has seen a growth of 2145%⁸ since mid-2014.⁹

5. How should taxes be assessed (e.g., THC content, weight, sales price) to eliminate the black market and sustain the costs of the legal program? At what stages – from seed to sale – should taxes be assessed? How much tax revenue can be expected from retail marijuana sales?

As rule of thumb, taxes should be high enough to cover the costs of regulation and to offset any of the negative externalities of an expanded cannabis market. That tax revenue will be necessary for the sustainability of the program. Higher taxes will also discourage excessive problem use for those who consume large quantities, and will reduce use by those who are especially prices sensitive like minors. The 10% excise tax and a 10% retail tax decided upon may be able to accomplish these revenue and public health goals.

An ounce of marijuana in Maine is currently between \$200 and \$300. Once Maine grows and produces an adequate supply to feed the market, it can expect retail prices to drop substantially. High THC content marijuana in Washington is currently around \$100. If you tax on an ad valorem basis at point of purchase you can push the price substantially higher without risking black market stability. Customers favor regulated, taxed, tested and labeled product if the price differential is not too onerous.

Some states have chosen to tax at different stages of growing, production and retail or some just at retail. Taxing earlier in the supply chain reduces regulatory burden and likelihood of tax

Maine's population over the age of 12 used marijuana compared to 14.74% of Vermont's, giving us an adjustment factor of .93. To reiterate, this is an extremely rough estimate and does not take into account age distribution or other demographic factors that will effect demand.

⁸ <https://www.502data.com/>

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<https://www.colorado.gov/pacific/sites/default/files/DOR%20MED%20April%201%202016%20Report%20to%20the%20JBC.pdf>

evasion. However, such an option may not be available for firms that are vertically integrated (as there are no wholesalers who sell to retailers). Firms often find creative ways to avoid taxes by bundling discounted cannabis with purchases of paraphernalia or clothing. Regulations need to be sufficiently detailed to avoid such trappings.

Taxing by THC content discourages producers from breeding the CBD out of cannabis and increasing the levels of THC and this is a public health win. As this approach has yet to be implemented, the effect on black markets are yet to be seen. Taxing per unit of THC is the most efficient way to reduce externalities as it avoids problems of ad valorem taxes, which erode with price declines, and weight-based taxes, which erode with inflation and often nudge the market toward more potent products. Some states are taking a dual approach, taxing on weight at the point of wholesale and levying an ad valorem excise at point of retail. Arguably this approach has combined benefits, but still is not perfect.

The trouble with taxing per unit of THC is that it is very difficult to obtain an accurate measure of THC for most herbal products. It might be possible to construct a THC-based tax structure for a market that exclusively sells oils and tinctures, whose potency can be measured with sufficient accuracy. Yet no cannabis market to date taxes on unit of THC. Maine could be the first.

Projecting tax revenues will largely depend on what choices Maine makes. Price-based taxes erode as the price of cannabis falls. This is a problem that Colorado is now discovering as tax revenues are declining alongside price. This isn't ideal as lower prices increase consumption. Knowing what we know from other states, Colorado now reports annual tax earnings of \$102 million. Washington reports \$189 million.

6. How have other states established enforcement and oversight capabilities, and which have been most successful? Please comment with special attention to security requirements for licensee facilities, banking challenges and diversion of products to other states.

At this point, we only have reliable data and information from Colorado and Washington, which have had operating markets for three years. Both states employ statewide seed to sale inventory systems. The regulations governing who can obtain a license and what requirements are needed are similar between the two. Licensees must submit to background checks, cannot have had certain drug-related criminal histories, and must comply with state and local zoning requirements. BOTEC staff has conducted a comparison across states with regard to security requirements for licensees (Pardo, 2014).

Some of these oversight capabilities have been useful to detect backdoor diversion and ensure that licensees comply with regulations. These include surprise inspection, background checks for all employees, secure rooms, regular auditing of inventory tracking systems and tax receipts,

underage buy operations, random product testing, amnesty containers at ports of exit, and investment in cannabis detection technology to detect roadside impairment as well as clandestine or unlicensed grow operations.

Maine may need some, all, or additional security rules. BOTEC will know more after consulting with local stakeholders. Maine is not Colorado; its law does not create loose at-home production that operate in a legal gray area. Colorado has had substantial problems with at-home caregivers and is now requiring that such individuals register with the state and have reduced the maximum number of plants such individuals can cultivate at any given time.

7. What types of contaminants should be tested under the marijuana testing program? What levels of contaminants are safe for public consumption?

There is great uncertainty in the area of product testing. Federal prohibition makes it hard for states to regulate the chemical inputs of cannabis cultivation. Some states have had to revise their contaminant thresholds given new information. Maine can adopt the prevailing regulatory approaches taken in other states, which limit the use of certain chemicals known to pose substantial health risks as well as the acceptable levels of mold and moisture. BOTEC staff and associates have worked with Washington state in the area of regulating product testing and could be of use to Maine in this regard.

8. How should marijuana products be packaged, labeled, advertised and sold in terms of serving size, potency and consumer safety?

This has been a difficult issue for other states, especially in Colorado. It's important that rules inform consumers as much as possible about the type of product, its contents, and the risks associated with its use. At the same time, product needs to safeguard against accidental ingestion, especially by children and adolescents.

Maine can adopt many different options here. The most rigorous approach that protects public health requires pre-approval for all products, packages and labels by regulators before retail sale. This is what Washington currently does. Maine will need to adopt a universal symbol for THC infused products as well as a standard dose per unit and serving size for all edible or drinkable products. Lessons from other states are very helpful in this regard. Most states limit a serving dose to 10mg of THC and a package cannot contain more than 10 servings, or 100mg.

Packages should be childproof and include sufficient information so that the consumer can readily ascertain the type, potency, and cannabinoid profile of the product. Warning labels should appear to inform the consumer not to drive or operate machinery while consuming the

product as well as that the product may be habit forming. These labels and packaging requirements can be adapted from other states that have regulated cannabis.

Regulations governing these components are well documented and familiar to BOTEC. Maine may want to limit the types of products that are available to consumers in order to avoid certain concerns. This includes avoiding the production and sale of cannabis-infused items above a certain threshold of THC or ban products that appeal to youth or are difficult to responsibly dose (granola or loose leaf infused products, products that mimic existing consumer goods, drinkables, etc).

9. How should the State balance or integrate the existing medical marijuana program with the adult-use market?

This is an ongoing issue in other states, like Washington, Colorado and California. The issue here is to ensure that nascent recreational markets can compete with medical and illicit markets. In Washington state BOTEC has determined that after two years, the loosely regulated medical market was successfully competing with the young recreational market. Washington state is now taking the appropriate steps to align both markets under one regulatory framework.

As of now, the emphasis has been on harmonizing the markets to migrate users of medical cannabis who may not be using the drug medically toward recreational cannabis. This requires a considerable effort on the part of regulators to sometimes make unpopular choices that restrict access to medical cannabis markets. This was more or less the case in Washington state. Maine could avoid some of these political issues by combining the regulation of both markets under one roof, as California is doing.

One way of doing this to grandfather in existing medical establishments, by giving them priority in licenses allocation for the first few years. This allows for a smoother rollout and a smoother transition if the state chooses to integrate both markets.

10. Free response – use this opportunity to share any other thoughts or insights you’d like the State to know.

Making cannabis legally available to all adults is highly likely to increase the prevalence of cannabis use disorder and risks increasing adolescent use. The system of legal availability should be designed to minimize those unwanted side-effects while displacing the illicit markets and allowing adults convenient access to cannabis products of known chemical composition