



Ethanol Control Toolkit Report

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Executive summary

Introduction

As highlighted by the Organization for Economic Co-operation and Development (OECD) *Illicit trade in alcohol is a significant threat to society, businesses and consumers, undermining good governance, the rule of law and citizens' trust in government and legal businesses and trade. It has a negative impact on the sales and profits of legitimate firms and on the economy in general, while posing major health and safety threats to consumers.*¹ While the production and sale of alcohol are regulated in many countries to ensure quality control and tax collection, the World Health Organization (WHO) expects the share of unrecorded alcohol globally to continue to rise, reaching an estimated 27.7% of consumption in 2025.² This underground market for counterfeit and unregulated alcoholic beverages represents a persistent and increasingly pressing challenge for policy makers worldwide.

This *Ethanol Control Toolkit* promotes the use of ethanol control programs as an effective measure for mitigating the production of illicit alcoholic beverages, disrupting illicit alcohol networks and protecting public health.

It delineates a 3-pillar approach to creating, implementing and monitoring an ethanol control program. It includes an *Ethanol Control Checklist*, designed for use by legislators and regulatory agencies to implement or fortify ethanol control systems. In cases where legislation governing ethanol controls is absent, the *Background Report* provides an adequate basis for drafting and introducing new, enabling legislation.

Understanding the Problem

Ethanol constitutes a significant economic sector worldwide, valued at approximately USD 90 billion. It is used as a feedstock for many applications including automotive transportation fuels, industrial applications, hand sanitizers, cosmetics, pharmaceuticals and foodstuffs.³ It is also a major ingredient in the production of alcoholic beverages.

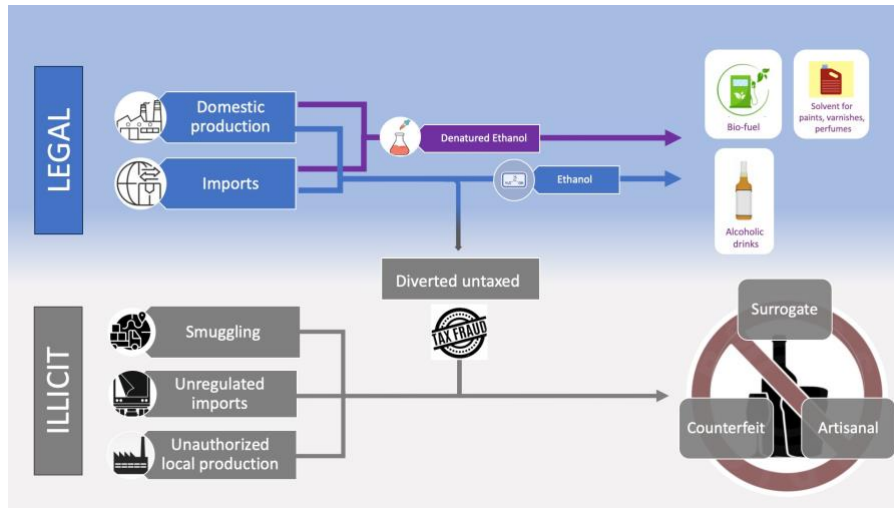
Because alcoholic beverages are heavily taxed by most governments, criminals can profit by producing and selling low-cost, illicit products. One primary method for lowering costs is to secure untaxed supplies of ethanol typically from (1) unregulated imports, (2) unregistered ethanol smuggled into the country, (3) ethanol diverted from untaxed industrial applications, (4) ethanol produced locally in quantities sufficient for commercial sales.

¹ OECD. (2022). *Illicit Trade in High-Risk Sectors: Implications of Illicit Alcohol for Public Health and Criminal Networks*. Paris: OECD Publishing. <https://doi.org/10.1787/1334c634-en>.

² The WHO expects the share of unrecorded alcohol globally to continue to rise, to an estimated 27.7% of consumption in 2025. See OECD. (2022). *Illicit Trade in High-Risk Sectors: Implications of Illicit Alcohol for Public Health and Criminal Networks*. Paris: OECD Publishing. <https://doi.org/10.1787/1334c634-en>.

³ Global Industry Analysts. (2023). *Ethanol - Global Strategic Business Report*. n.p.: Global Industry Analysts. <https://www.researchandmarkets.com/report/ethanol>

Notably, the COVID-19 pandemic exacerbated the challenge of properly managing the supply of ethanol, because surpluses of ethanol initially designated for hand sanitizer is being redirected to other markets including illegal diversion to the production of counterfeit alcoholic beverages.⁴



Illicit ethanol supply chain

Health and Economic Costs

According to the Organisation for Economic Co-operation and Development (OECD), the public health costs and personal tragedies from illicit alcohol are staggering. A significant concern is consumer exposure to health risks associated with toxic illicit alternatives.⁵ As noted by the World Health Organization (WHO), the consumption of illicitly or informally produced alcohol can have negative health consequences due to toxic substances and higher ethanol content.⁶ These products also often fail to comply with sanitation, quality, and safety regulations, with the most perilous ones contaminated by toxic additives, such as methanol, posing severe health threats, including poisoning and fatalities.⁷

In terms of socio-economic costs, illicit trade in alcohol (1) deprives governments of tax revenues, impacting public services and infrastructure, (2) Impedes governments' capacity to regulate legally produced alcohol,⁸ (3) undermines legitimate, tax-paying businesses by associating their brands with inferior, illicit products, (4) diverts resources to organized crime, perpetuating illegal activities and compromising the rule of law.⁹

⁴ Joshi, G. (2023, May 28). Counterfeit Liquor : India Perspective. [Post]. LinkedIn. <https://www.linkedin.com/pulse/counterfeit-liquor-india-perspective-gopal-joshi/>; see also Bomey, N. (2021, April 8). Panic buying? Not anymore. Suddenly there's a surplus of hand sanitizer. USA Today. <https://www.usatoday.com/story/money/2021/04/08/hand-sanitizer-deals-donations-surplus-panic-buying-pandemic/7120815002>

⁵ OECD. (2022). Illicit Trade in High-Risk Sectors: Implications of Illicit Alcohol for Public Health and Criminal Networks. Paris: OECD Publishing. <https://doi.org/10.1787/1334c634-en>

⁶ WHO. (2010). Global strategy to reduce the harmful use of alcohol. Geneva: World Health Organization. <https://www.who.int/publications/i/item/9789241599931>

⁷ WHO. (2010). Global strategy to reduce the harmful use of alcohol. Geneva: World Health Organization. http://www.afro.who.int/sites/default/files/2017-06/9789241599931_eng.pdf

⁸ WHO. (2010). Global strategy to reduce the harmful use of alcohol. Geneva: World Health Organization. http://www.afro.who.int/sites/default/files/2017-06/9789241599931_eng.pdf

⁹ OECD. (2022). Illicit Trade in High-Risk Sectors: Implications of Illicit Alcohol for Public Health and Criminal Networks. Paris: OECD Publishing. <https://doi.org/10.1787/1334c634-en>.

Ethanol control

To safeguard public health and reduce the risks associated with illicit alcohol, governments enact and enforce strict laws and regulations governing the trade of ethanol to prevent its diversion for illegal or unauthorized purposes. The most successful ethanol control strategies employ a three-pillar approach, encompassing the creation, implementation, and vigilant monitoring of ethanol control measures.

Pillar 1) Regulatory framework

- **International:** Successful ethanol control strategies include robust legislative and regulatory frameworks that govern the ethanol supply chain, including the regulation and monitoring of ethanol importation.
- **Domestic:** Once introduced into the market, either by import or domestic production, regulations should establish robust tracking and regulatory mechanisms to foster transparency and accountability in the ethanol supply chain. These measures include stringent record-keeping requirements, such as the quantity, source, destination, and purpose of ethanol shipments, robust license / permit requirements for all businesses or individuals trading in ethanol.
- **Product regulation:** An important complement to this system is the introduction and enforcement of a comprehensive denaturing program and labeling mandates. By rendering industrial ethanol unsuitable for human consumption, denaturing is a powerful deterrent to those attempting to illegally divert untaxed ethanol supplies to beverage markets. A denaturing program also helps to ensure compliance with regulatory standards and safeguards tax revenues.

Pillar 2) Enforcement

- **International:** Effective ethanol control programs employ a range of enforcement measures to monitor borders to detect, intercept, and deter smuggled or non-compliant ethanol. Customs and regulatory frontline agencies must be equipped and trained to verify the authenticity and compliance of ethanol, including the level and type of denaturant.
- **Domestic:** Regulatory bodies and enforcement agencies play a vital role in ensuring that processes are carried out correctly and in accordance with the law. Effective interagency collaboration and information sharing among the different agencies involved in oversight of ethanol control regulations are critical to oversee compliance and prevent irregularities. Additionally, through the rigorous enforcement of these regulations, governments can substantially enhance their tax revenues by efficiently preventing tax evasion and revenue leakage.
- **Penalties:** Strict penalties for violations of regulations should also be consistently enforced, acting as both a deterrent and a measure underlining the government's commitment to upholding the integrity of ethanol control measures.

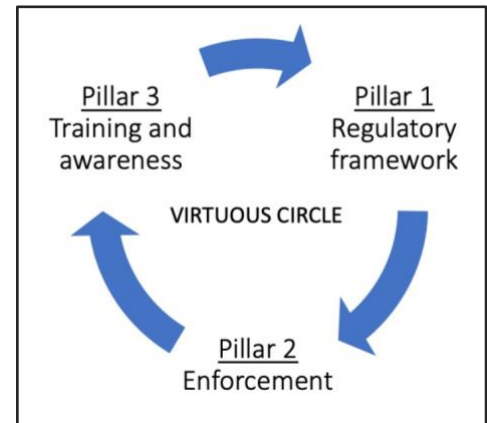
Pillar 3) Training and awareness

- **Stakeholder engagement:** Once the regulatory framework and enforcement regime are firmly established, their ongoing effectiveness needs to be sustained. The establishment of a permanent ethanol control dialogue between government, key producers and affected parties ensures the continuous improvement and alignment of regulatory practices, fostering a more robust and cooperative approach to ethanol control for the benefit of public safety and industry integrity. This collaborative approach ensures that both regulatory and industry perspectives are considered, enhancing the overall effectiveness of the framework.
- **Education and awareness:** The sustainability of an effective ethanol control program hinges on the ongoing implementation of training and awareness initiatives. These efforts are aimed at educating enforcement agencies, industry stakeholders, and consumers about the inherent risks associated with the illicit alcohol trade and the critical role that ethanol control, safety protocols, denaturation and regulatory compliance plays in upholding public health.

The success of an ethanol control program relies on the harmonious functioning of all three pillars. Conversely, any vulnerabilities within these pillars create opportunities for exploitation by individuals seeking to divert ethanol for illicit purposes.

The importance of intergovernmental coordination and cooperation with the private sector has been emphasized by the OECD's view that the *approach that governments take when governing the production and sale of alcohol can leave the door open for the illicit alcohol market, unintentionally stimulating it. This is particularly the case when the governance frameworks do not assure effective co-ordination and information sharing between government agencies and the public, private and civil society sectors.*¹⁰

The *Ethanol Control Toolkit* is the result of a comprehensive benchmarking exercise examining some of the most successful government initiatives aimed at regulating the ethanol supply chain. This includes successful programs from, inter alia, the United States, the European Union, and the United Kingdom. The *Toolkit's* portfolio of proven and recognized best practices serves as a valuable resource for legislators and regulatory agencies, enabling them to examine each pillar and pinpoint areas in need of enhancement and refinement. Together, the *Background Report* and its associated *Checklist* empower regulators, lawmakers, and collaborative partners with the knowledge and tools required to fortify ethanol control systems and effectively combat the illicit alcohol trade.



¹⁰ OECD. (2022). *Illicit Trade in High-Risk Sectors: Implications of Illicit Alcohol for Public Health and Criminal Networks*. Paris: OECD Publishing. <https://doi.org/10.1787/1334c634-en>.

Ethanol Control Checklist

Pillar 1: [Regulatory Framework](#)

The necessary prerequisite to enable the establishment of an ethanol control program is the enactment of legislation that outlines the program's objectives, provisions and measures. Such legislation will also confer authority to a regulatory agency to promulgate rules and enforcement compliance.

The following are steps for establishing a comprehensive regulatory framework for ethanol controls that encompasses both import and domestic ethanol supplies:

INTERNATIONAL

- [Require importers and exporters](#) of ethanol to register with the appropriate **government agencies** and adhere to stringent regulations to ensure transparency and accountability in the ethanol supply chain.
- Explore [mutual recognition](#) of denaturation procedures. Similar to the EU's approach, regional blocs and trade partners with well-established denaturing programs should work towards recognizing the denaturation processes of participating countries. This incentivizes international denaturing practices by ensuring that alcohol completely denatured in one country is recognized as such when transported to another country.

DOMESTIC

- Appoint [supervisory/regulatory bodies](#) to promulgate and enforce rules governing the legislated ethanol controls.
- Establish measures enabling authorities to [track and regulate domestic ethanol production and trade](#), including inspections, testing protocols, and audits of record-keeping.
- Require [licenses / permits](#) for all businesses or individuals intending to manufacture, trade or use ethanol, including denatured ethanol.
- Mandate accurate [record-keeping](#) including precise record-keeping practices concerning the acquisition, sale, storage, and utilization of ethanol, including denatured ethanol.
- Promote ethanol denaturation through [tax incentives](#), such as exempting lawfully denatured ethanol from excise tax obligations and imposing reduced tariffs or duties on imported denatured ethanol in comparison to industrial-grade ethanol. Grant preferential treatment to denatured ethanol within trade agreements.
- [Criminalize](#) any efforts to circumvent legislated ethanol controls, such as **tampering with denatured ethanol**. Enact strict penalties for any attempts to divert ethanol or reverse or circumvent denaturation, making such actions illegal and subject to legal consequences.

PRODUCT REGULATION

- Enable comprehensive [denaturing legislation](#)** to govern the entire lifecycle of denatured ethanol, including its production, importation, exportation, distribution, and utilization.
- Delineate compliant [denaturation formulas](#)** to specify approved denaturants and detailed instructions on the quantities and procedures for mixing the denaturing agents with ethanol to achieve the desired level of denaturation. Given the possibility of criminal attempts to reverse / circumvent denaturing, it is important that control programs consider consumer safety.
- Mandate denaturing [labeling and dyes](#)** to ensure easy identification and differentiation of denatured alcohol from potable spirits. These mandates should require that denatured ethanol be appropriately dyed and clearly labeled as unsuitable for human consumption, accompanied by explicit warnings regarding toxicity.

Pillar 2: [Enforcement](#)

Once the regulatory framework is in place, it is important to ensure compliance with regulations to effectively prevent the release of untaxed alcohol into circulation and its subsequent illegal sale for consumption. Regulatory agencies conduct inspections and audits to ensure that processes are carried out correctly and in accordance with the approved formulas and guidelines. By tracking data on incidents or concerns tied to denatured alcohol (e.g., alcohol-related poisonings, hospitalizations, or accidents) authorities can assess whether denatured alcohol is successfully deterring consumption and minimizing harm. Over time, a comparison of these statistics can provide insights into the tangible impact of denaturing initiatives.

The following are steps to ensure the effective enforcement of regulations governing ethanol trade and prevent its unauthorized or illegal diversion:

INTERNATIONAL

- Monitor [border crossings](#):** Implement systems to monitor ethanol imports at border crossings to detect, intercept, and deter smuggled or non-compliant ethanol.

DOMESTIC

- Empower [Regulatory Oversight](#):** Provide supervisory/regulatory bodies with the mandate and resources needed to properly monitor and enforce ethanol control regulations.
- Conduct [regular inspections](#):** Carry out routine inspections of producers, distributors, and users of ethanol, including denatured ethanol, to confirm adherence to established standards across all stages, from production to usage.
- Support [law enforcement](#):** Ensure adequate funding and regular training for law enforcement officials responsible for enforcing ethanol laws and regulations.

- ❑ Promote [interagency cooperation](#) and information sharing among different agencies involved in oversight of ethanol control regulations.
- ❑ Enhance [testing capabilities](#): Ensure that enforcement agencies are well-equipped with the necessary testing equipment and authentication methods to verify the authenticity and compliance of ethanol. Offer guidelines and protocols on approved testing methods and testing facilities to ascertain the presence and proportions of denaturing agents in denatured ethanol.
- ❑ Enforce [penalties for regulation violations](#), including fines, license revocation, or legal actions. Take tangible enforcement actions against violations, including imposing fines, license revocation, or legal actions.

Pillar 3: [Training and Awareness](#)

The sustainability of an effective ethanol denaturing program relies on training and awareness-building initiatives to educate industry stakeholders, enforcement agencies and consumers about the importance of ethanol controls, including the denaturation process, safety protocols, and the significance of regulatory compliance.

A crucial element of this is educating stakeholders on the risks associated with illegal alcohol consumption and the critical role ethanol control plays in upholding public health.

The following are steps to educate industry stakeholders, enforcement agencies and consumers about the importance of ethanol control:

STAKEHOLDER ENGAGEMENT

- ❑ Promote [stakeholder dialogue](#): Establish a permanent dialogue between government, key producers and affected parties, to foster a more robust and cooperative approach to ethanol control. This collaborative approach ensures that both regulatory and industry perspectives are considered, enhancing the overall effectiveness of the framework. Public-private partnerships can also play a vital role in disseminating information and promoting responsible consumption practices.

EDUCATION AND AWARENESS

- ❑ [Educate Enforcement Personnel](#): Implement regular training programs for law enforcement officers, regulatory agencies and Customs personnel, equipping them with the necessary knowledge and skills to enforce ethanol control regulations effectively. Consider joint training opportunities and exercises between regulators and enforcement, industry stakeholders, and relevant parties to encourage a culture of mutual support. Leverage the private sector's expertise through workshops and training with government stakeholders, aiming to bolster the detection of illicit alcohol.
- ❑ Develop [Key Performance Indicators \(KPIs\)](#) for evaluating the effectiveness of ethanol control regulations. Monitoring and analyzing KPIs such as regulatory adherence,

incident rates, annual volume of traded (denatured) ethanol, revenue protection, safety incidents, border seizures, and import/export trends provides regulatory authorities with insights into compliance, enforcement, and the overall impact of regulatory efforts, ensuring fiscal integrity and enhancing public safety.

- Establish [reporting systems](#):** Develop reporting systems and routines where incidents or concerns related to ethanol control, especially denatured ethanol, can be promptly reported and addressed.
- Develop a [compliance checklist](#):** Create and disseminate a checklist for public use, clearly outlining the requirements for compliance with ethanol control regulations at each stage of the process (i.e., import control, local production and denaturization). Detailed training and education will be necessary for implementation of complicated denaturation programs and safety protocols.
- Organize [awareness campaigns](#):** Launch awareness campaigns that emphasize the risks associated with illicit alcohol consumption and underscore the critical role of ethanol control programs, especially denaturation, in protecting public health.

Background report on the key elements of an Ethanol Control Program

Introduction

Size and shape of illicit alcohol markets

Although market characteristics differ across countries, the problem of illicit alcohol exists in every region, in developed and developing countries, urban and rural areas, and higher income and lower-income neighborhoods alike. Moreover, illicit alcohol is often consumed by more vulnerable populations, such as people of low socioeconomic status, rural populations, and people with alcohol dependence.¹¹

Illicit trade in alcohol is widespread. According to Euromonitor's 2018 Global Study on Illicit Alcohol, 1 in 4 alcohol bottles are illicit, representing 25.8 percent of all global consumption.¹² These findings correspond to World Health Organization (WHO) estimates that unrecorded alcohol¹³ accounts for 25.5¹⁴ percent of total worldwide adult alcohol consumption and is expected to continue to rise to an estimated 27.7% of consumption in 2025.¹⁵

Notably, certain regions and countries witness even higher rates of illicit alcohol consumption. For instance, in the Americas, the figure stands at 14 percent, while in the eastern Mediterranean region, it soars to an alarming 67 percent. Income levels are also an important determinant. In high-income countries, unrecorded alcohol constitutes a smaller share, at an average of 11 percent, compared to 37 percent and 44 percent in lower income and lower middle-income countries.¹⁶ For instance, in countries like Zambia¹⁷ and the Dominican Republic¹⁸, illicit alcohol consumption is estimated at a 69 percent and 30 percent, respectively.

The higher prevalence of illicit alcohol in lower-income countries can be attributed to several factors. Consumers in these regions often seek lower-priced alternatives to legal (often heavily taxed) products, or they may turn to illicit options due to restrictions on the

¹¹ OECD. (2022). Illicit Trade in High-Risk Sectors: Implications of Illicit Alcohol for Public Health and Criminal Networks. Paris: OECD Publishing. <https://doi.org/10.1787/1334c634-en>.

¹² Euromonitor International. (2018). Size and Shape of the Global Illicit Alcohol Market. London: Euromonitor International. https://www.tracit.org/uploads/1/0/2/2/102238034/illicit_alcohol_-_white_paper.pdf

¹³ Unrecorded alcohol is alcohol not reflected in official statistics of the country of production, the country of consumption or both.

¹⁴ World Health Organization. (2018). Global status report on alcohol and health 2018. Geneva: World Health Organization. <http://apps.who.int/iris/bitstream/handle/10665/274603/9789241565639-eng.pdf?ua=1>

¹⁵ OECD. (2022). Illicit Trade in High-Risk Sectors: Implications of Illicit Alcohol for Public Health and Criminal Networks. Paris: OECD Publishing. <https://doi.org/10.1787/1334c634-en>.

¹⁶ OECD. (2022). Illicit Trade in High-Risk Sectors: Implications of Illicit Alcohol for Public Health and Criminal Networks. Paris: OECD Publishing. <https://doi.org/10.1787/1334c634-en>.

¹⁷ Euromonitor International. (2018). Size and Shape of the Global Illicit Alcohol Market. n.p.: Euromonitor International. https://www.tracit.org/uploads/1/0/2/2/102238034/illicit_alcohol_-_white_paper.pdf

¹⁸ Euromonitor International. (2017). Illegal alcohol in Dominican Republic: A custom report compiled by Euromonitor International for Cerveceria Nacional Dominicana. n.p.: Euromonitor International. https://www.tracit.org/uploads/1/0/2/2/102238034/emi_cnd_illegal_alcohol_market_in_dr_final_report_2017.pdf

availability of legal alcohol. Additionally, illicit traders tend to have an easier time infiltrating distribution channels in these areas, further exacerbating the issue.¹⁹

This complex interplay of economic factors, availability, and distribution dynamics underscores the urgency of addressing the illicit alcohol trade on a global scale.

Illicit alcoholic beverages are found in both informal channels, such as street stalls, traditional markets, or small independent stores that did not pay all the required taxes, as well as in formal establishments like resorts, restaurants and night clubs.²⁰ In recent years the distribution landscape has grown increasingly complex because of globalization and an increasingly digitalized world, with illicit players worldwide taking advantage of new and online distribution channels that are unregulated or poorly regulated.

Furthermore, the impositions of bans and restrictions on the sale or supply of alcoholic beverages during the COVID-19 pandemic has expanded markets for illicit supplies and has helped entrench the production and distribution capabilities of illicit traders.²¹ As noted by the OECD *“The pandemic provided wide opportunities for illicit traders to adjust and expand their operations as government lockdowns, bans and other restrictions disrupted the alcohol market and created shortages. Overall, the pandemic gave impetus to the ongoing illicit trade in alcohol, creating more sophisticated international networks, logistics routes, and manufacturing techniques.”*²²

What is Illicit Alcohol?

Illicit trade in alcohol encompasses a wide variety of illegal activity that is typically characterized as:

- **Contraband/Smuggled Alcohol:** Alcohol with original branding that has been illegally imported / smuggled into a jurisdiction and sold, evading tariffs/customs. This includes beverages brought across the border via organized smuggling or in excess of the applicable traveler’s regulated allowance.
- **Counterfeit Alcohol:** Fraudulent imitations of legitimate branded products, including refilling, falsification and tampering. These beverages infringe the intellectual property rights of legitimate producers and present brand reputational risk and potential liability. It is often produced in illicit factories and sometimes substitutes lower grade alcohol not intended for human consumption such as denatured ethyl alcohol.
- **Illicit Artisanal:** Alcoholic beverages produced following artisanal practices, including home production. Artisanal alcoholic beverages are considered illicit if they are produced for commercial purposes, and if their production and / or sale violate local law.
- **Tax Leakage:** Legally produced alcohol beverages on which the required excise tax is not paid in the jurisdiction of production.
- **Non-conforming Alcohol / Surrogate:** Products that are not compliant with production processes, guidelines, or labeling legislation. Includes products produced with denatured alcohol or illegal industrial alcohol not produced for human consumption.

¹⁹ OECD. (2022). Illicit Trade in High-Risk Sectors: Implications of Illicit Alcohol for Public Health and Criminal Networks. Paris: OECD Publishing. <https://doi.org/10.1787/1334c634-en>.

²⁰ Gajanan, M. (2017, August 15). 10,000 Gallons of Tainted Alcohol Were Seized From Mexican Resorts. TIME. <https://time.com/4900991/mexican-resort-alcohol-unsanitary/>

²¹ OECD. (2022). Illicit Trade in High-Risk Sectors: Implications of Illicit Alcohol for Public Health and Criminal Networks. Paris: OECD Publishing. <https://doi.org/10.1787/1334c634-en>. See also TRACIT. (2021). Prohibition, Illicit Alcohol and Lessons Learned from Lockdown. New York: Transnational Alliance to Combat Illicit Trade. https://www.tracit.org/uploads/1/0/2/2/102238034/tracit_prohibition_illicit_alcohol_and_lessons_learned_from_lockdown_jan2021_hr.pdf.

²² OECD. (2022). Illicit Trade in High-Risk Sectors: Implications of Illicit Alcohol for Public Health and Criminal Networks. Paris: OECD Publishing. <https://doi.org/10.1787/1334c634-en>.

Negative impacts

According to the OECD, the public health costs and personal tragedies from illicit alcohol are staggering. A significant concern is consumer exposure to health risks associated with toxic illicit alternatives.²³ As highlighted by the WHO, the consumption of illicitly or informally produced alcohol can have severe negative health consequences due to toxic substances and higher ethanol content.²⁴ These illicit substitutes not only fail to comply with sanitary, quality, and safety regulations but the most hazardous ones are contaminated with toxic chemical additives, such as methanol, posing severe health threats, including cases of poisoning and fatalities.²⁵

Beyond the significant health concerns, the illicit alcohol trade exerts a multifaceted and detrimental impact on society at large:

Revenue drain: Illicit alcohol trade significantly diminishes government tax revenues, which, in turn, has adverse effects on public services and infrastructure. The substantial loss of revenue hampers a government's ability to allocate resources effectively, impacting sectors such as healthcare, education, and transportation.²⁶

Regulatory challenge: This underground trade also poses a considerable challenge to governments in terms of regulating legally produced alcohol. The allocation of resources to tackle the illicit market diverts attention and resources away from enforcing proper regulations and ensuring the safety and quality of legally produced alcoholic beverages.²⁷

Undermines legitimate trade: Legitimate, tax-paying businesses suffer the consequences of illicit trade as well. Their brands are often unfairly associated with inferior, illicit products, eroding consumer trust and potentially leading to reduced sales and reputational damage. This can have a ripple effect on employment and economic stability within the alcohol industry.²⁸

Organized crime empowerment: Perhaps most concerning is how the illicit alcohol trade contributes to the empowerment of organized crime networks. Illicit trade channels profits into the hands of criminal enterprises, enabling them to perpetuate various illegal activities. This not only compromises public safety but also undermines the rule of law, posing a significant threat to the security and stability of communities and nations alike.²⁹

²³ OECD. (2022). *Illicit Trade in High-Risk Sectors: Implications of Illicit Alcohol for Public Health and Criminal Networks*. Paris: OECD Publishing. <https://doi.org/10.1787/1334c634-en>.

²⁴ WHO. (2010). *Global strategy to reduce the harmful use of alcohol*. Geneva: World Health Organization. <https://www.who.int/publications/i/item/9789241599931>

²⁵ WHO. (2010). *Global strategy to reduce the harmful use of alcohol*. Geneva: World Health Organization. http://www.afro.who.int/sites/default/files/2017-06/9789241599931_eng.pdf.

²⁶ OECD. (2022). *Illicit Trade in High-Risk Sectors: Implications of Illicit Alcohol for Public Health and Criminal Networks*. Paris: OECD Publishing. <https://doi.org/10.1787/1334c634-en>; TRACIT. (2019). *Mapping the Impact of Illicit Trade on the Sustainable Development Goals*. New York: Transnational Alliance to Combat Illicit Trade. <https://www.tracit.org/featured-report-illicit-trade-and-the-unsdgs.html>

²⁷ WHO. (2010). *Global strategy to reduce the harmful use of alcohol*. Geneva: World Health Organization. http://www.afro.who.int/sites/default/files/2017-06/9789241599931_eng.pdf.

²⁸ OECD. (2022). *Illicit Trade in High-Risk Sectors: Implications of Illicit Alcohol for Public Health and Criminal Networks*. Paris: OECD Publishing. <https://doi.org/10.1787/1334c634-en>; TRACIT. (2021). *Mapping the Impact of Illicit Trade on the Sustainable Development Goals – SDG 16*. New York: Transnational Alliance to Combat Illicit Trade. https://www.tracit.org/uploads/1/0/2/2/102238034/tracit_examining_the_negative_impacts_of_illicit_trade_on_sdg_16.pdf

²⁹ OECD. (2022). *Illicit Trade in High-Risk Sectors: Implications of Illicit Alcohol for Public Health and Criminal Networks*. Paris: OECD Publishing. <https://doi.org/10.1787/1334c634-en>.

Addressing illicit trade in alcohol is an imperative not only for economic reasons but also for safeguarding public health, fostering a fair and competitive business environment, and maintaining the integrity of legal systems.

Understanding the role of ethanol in the production of illicit alcohol

Ethanol (ethyl alcohol) is a major ingredient in the production of alcoholic beverages. It serves as a unifying ingredient that imparts distinct flavors, intoxicating effects, and aromas to various drinks. Consequently, understanding the role of ethanol in the production of illicit alcohol is a critical aspect of addressing this complex issue and implementing effective countermeasures.

Ethanol: A valuable and versatile commodity with diverse applications

Ethanol constitutes a significant economic sector worldwide. In 2022, it was valued at USD 89.7 billion, with projections suggesting growth to USD 137.8 billion by 2030, at a compound annual growth rate (CAGR) of 5.5%.³⁰ The global ethanol market is primarily divided into two main categories: 1) Biofuel (for fuel blending) and 2) Industrial and food grade (including alcoholic beverages):

1. **Biofuel.** Ethanol is a critical renewable resource widely utilized in automotive fuel blending programs. Approximately 94% of the world's total ethanol production, which amounts to 1.1 billion hectoliters, is dedicated to these fuel blending initiatives.³¹
2. **Industrial and food grade.** Ethanol is an essential raw material for several industries, (e.g., pharmaceutical and chemical), as well as the food and beverage sector. Industrial ethanol accounts for approximately 3.5% of global ethanol production, whereas food and beverage-grade ethanol make up about 2.8% of the total. As a solvent, ethanol is a vital component in the production of paints, coatings, inks, and pharmaceutical formulations. Additionally, its antiseptic qualities make it indispensable for manufacturing disinfectants, hand sanitizers, and cleaning agents.

Additionally, ethanol holds a central role in the production of alcoholic beverages, where it imparts distinct flavors, intoxicating effects, and aromatic profiles. Food and beverage-grade ethanol is always undenatured, maintaining its purity for consumption, while industrial ethanol is typically denatured to render it unsuitable for human consumption, aligning with its intended industrial applications.

³⁰ Global Industry Analysts. (2023). Ethanol - Global Strategic Business Report. n.p.: Global Industry Analysts. <https://www.researchandmarkets.com/report/ethanol>

³¹ Euromonitor. (2023). Ethanol Industry overview.

Diverting Ethanol to Produce Illicit Alcohol

Industrial ethanol and ethanol intended for alcoholic beverages are taxed very differently. Alcoholic beverages are subject to significant excise taxes, sales taxes, and sometimes customs duties. These taxes result in higher retail prices for alcoholic beverages compared to production costs.

In contrast, ethanol for non-drinking purposes (industrial ethanol) is usually granted excise tax exemptions or tax refunds and rebates to alleviate the tax burden on industries using ethanol for applications like food production, pharmaceuticals, cosmetics, and cleaning products.

Unfortunately, the substantial price gap between legally taxed alcoholic beverages and low cost/untaxed industrial ethanol can serve as a powerful incentive for criminals to divert industrial alcohol to produce illicit alcoholic products. Diverted industrial ethanol is a significant source of alcohol for these operations because it is cheaper and can be more readily available than traditional beverage alcohol sources. Due to ethanol's crucial role in distilled spirits production, criminals seek to maximize profits by acquiring lower-cost, untaxed industrial ethanol and diverting it to produce illicit alcohol, primarily counterfeit³³ alcoholic beverages and surrogates.³⁴ Alternatively, counterfeiters may simply mix diverted industrial ethanol with water, flavorings, and other additives to mimic the appearance and taste of genuine alcoholic beverages.

Acquiring illicit ethanol can be achieved through various means, such as importing or smuggling low-cost foreign supplies, diverting industrial ethanol or operating (unauthorized) local ethanol production factories.

Notably, illegal diversion of ethanol is often accompanied by significant health risks because industrial ethanol (diverted to beverage use) may have less rigorous controls during distillation, resulting in above-threshold quantities of toxic substances like methanol. In other

Importance of rational tax incentives

In many developed markets, denatured ethyl alcohol is often subject to lower tax rates compared to undenatured ethyl alcohol, as an incentive for industrial applications. However, this practice is not universally applied. For instance, in Zambia, there is no distinction in excise taxes between "Undenatured Ethyl Alcohol of alcoholic strength by volume of 80% or greater" and its denatured counterpart; both are taxed at the same rate of 125%.³² As a result, there is no financial incentive for importers to denature ethanol, making these imports more susceptible to diversion for illicit alcoholic beverages.

³² Zambia Revenue Authority. (2020). Excise Duty – A Brief Guide. n.p.: Zambia Revenue Authority. <https://www.zra.org.zm/wp-content/uploads/2020/01/Excise-Duty.pdf>

³³ Counterfeit alcohol refers to deceptive replicas of genuine branded alcoholic products, encompassing activities such as refilling, forgery, and tampering. These beverages infringe the intellectual property rights of legitimate producers and present brand reputational risk and potential liability. Diverted industrial ethanol is a significant source of alcohol for these operations because it can be cheaper and more readily available than traditional beverage alcohol sources. Counterfeit alcohol producers may mix diverted industrial ethanol with water, flavorings, and other additives to mimic the appearance and taste of genuine alcoholic beverages.

³⁴ Surrogate alcohol, also known as "alcohol surrogates" or "alcohol substitutes," refers to substances that are not traditional alcoholic beverages but are used as a substitute for them to achieve intoxication. These substances are typically high-proof and may include products like medicinal compounds, aftershaves, hair spray, industrial spirits, fire lighting liquids, or other chemicals that contain ethanol or methanol. Most people turn to these as a last resort either out of desperation or being unable to afford consumable alcoholic beverages. Besides alcohol, there are many other toxic substances in surrogate alcohol such as hydrogen peroxide, antiseptics, ketones, as well as alcohols other than ethanol (drinking alcohol) such as isopropanol and methanol. Consuming these substances can lead to severe health issues, including poisoning, organ damage, and even death.

cases, criminals intentionally mix ethanol with surrogates such as methanol, rubbing alcohol, or industrial alcohol not intended for human consumption.³⁵

The COVID-19 pandemic exacerbated this problem because a considerable surplus of ethanol initially designated for hand sanitizer production has been redirected to produce counterfeit alcoholic beverages.³⁶

Governments also face challenges with "technical smuggling" of ethanol. This includes the use of various deceptive or fraudulent methods to evade import duties, taxes, and regulatory controls imposed on the importation and sale of ethanol to make it appear as though the ethanol being imported is compliant with all relevant laws and regulations when it is not. This includes underreporting, falsifying documentation or mislabeling to evade regulatory requirements or to pay lower import duties and taxes. As an example, industrial-grade ethanol may be falsely labeled as denatured to circumvent excise taxes.

Local production of unauthorized or illicit ethanol, sometimes referred to as illicit artisanal, remains a concern in some regions, where individuals engage in the clandestine production of ethanol, evading regulatory oversight and taxes. Furthermore, in certain countries, medicinal alcohol or pharmaceutical-grade ethanol, with an 80 percent ethanol content or higher, is available for purchase without prescription. When these surrogate products are not denatured, they can easily be diverted and consumed as a substitute for conventional alcoholic beverages.

Smuggling and unauthorized production of ethanol are significant problems that contribute to illicit alcohol incidents globally. For example,

- The Dominican Republic Health Ministry reported in June 2020 that 215 people died after drinking a local illicit alcoholic beverage known as Clerén.³⁷ Medical tests concluded it contained more than 50% toxic methanol. Many people believed that consuming Clerén was an effective way to fight the COVID-19 virus.³⁸
- Citing recent data from the National Commission against Addictions (CONADIC), the Mexican journal El País reported the death of nearly 200 people in 11 Mexican states from suspected illicit alcohol poisoning in a period of just three months.³⁹ The deaths occurred as people who sought to circumvent the dry laws were poisoned by contraband or counterfeit alcohol.⁴⁰

³⁵ OECD. (2022). Illicit Trade in High-Risk Sectors: Implications of Illicit Alcohol for Public Health and Criminal Networks. Paris: OECD Publishing. <https://www.oecd-ilibrary.org/sites/f39cc689-en/index.html?itemId=/content/component/f39cc689-en>

³⁶ Joshi, G. (2023, May 28). Counterfeit Liquor : India Perspective [LinkedIn Post]. <https://www.linkedin.com/pulse/counterfeit-liquor-india-perspective-gopal-joshi/>; see also Bomey, N. (2021, April 8). Panic buying? Not anymore. Suddenly there's a surplus of hand sanitizer. USA Today. <https://www.usatoday.com/story/money/2021/04/08/hand-sanitizer-deals-donations-surplus-panic-buying-pandemic/7120815002>

³⁷ Hoy, P. (2020, June 24). Suman 215 los muertos por ingerir clerén. Hoy Digital. <https://hoy.com.do/suman-215-los-muertos-por-ingerir-cleren/>

³⁸ López, D. (2020, April 26). 109 people die after drinking liquor they believed prevented coronavirus. AS. https://en.as.com/en/2020/04/25/other_sports/1587847366_185865.html

³⁹ InSight Crime. (2020, September 22). El licor adulterado ha matado mexicanos en varios estados, pero su mercado crece en la pandemia. Sin Embargo. <https://www.sinembargo.mx/22-09-2020/3864425>

⁴⁰ La Verdad. (2020, June 14). Mueren 189 personas por consumo de alcohol adulterado de mayo a junio. La Verdad. <https://laverdadnoticias.com/mexico/Mueren-189-personas-por-consumo-de-alcohol-adulterado-de-mayo-a-junio-20200614-0103.html>

- There are multiple accounts of smuggling significant levels of illicit ethanol into Kenya, from Uganda⁴¹ and Tanzania.⁴² Kenya estimates that it loses over USD 50 million in revenue every year through counterfeit alcohol, with a significant amount made from illegally obtained ethanol.⁴³
- Ethanol smuggling is also a problem in India, where Punjab and Mohali officials dismantled an organized crime group involved in the illicit transportation of mass quantities of extra neutral alcohol (ENA) into the state in 2021. The illegal consignment was destined for a bottling plant in Chandigarh, with the potential to produce more than 100,000 bottles of illicit liquor.⁴⁴
- Officers from Her Majesty's Revenue and Customs seized more than 9,000 bottles of counterfeit vodka at an illegal distillery operation at Leicestershire farm in the UK in 2011. Along with fake labels and manufacturing equipment, the seizure uncovered 25,000 liters of anti-freeze which was being illicitly repurposed to produce counterfeit vodka. To obscure its origin, the illicit operation utilized bleach to remove the purple color, which is typically added to denatured alcohol to distinguish it from consumable spirits.⁴⁵
- Research conducted by the Polish Ministry of Finance, found that the majority of illicit spirits (7 out of a total of 12 million liters of pure alcohol/year) consumed in Poland between 2009 and 2011 were derived from decontaminated/purified industrial alcohol. This is equivalent to a 6% loss of the total annual excise duty receipts from alcohol.⁴⁶

⁴¹ Nalianya, J. (2021, June 28). 29,000 litres of bootleg ethanol from Uganda seized. The Star. <https://www.the-star.co.ke/counties/western/2021-06-28-29000-litres-of-bootleg-ethanol-from-uganda-seized/>

⁴² Mkanyika, L. (2021, June 16). Kenya: Police Seize Sh7 Million Illegal Ethanol at Taveta Border Post. allAfrica. <https://allafrica.com/stories/202106170048.html>

⁴³ Okumu, W. (2022, July 4). Smuggled ethanol pours Kenya's revenue down the drain. ISS Today. <https://issafrica.org/iss-today/smuggled-ethanol-pours-kenyas-revenue-down-the-drain>

⁴⁴ Hindustan Times. (2021, December 30). Mohali police, excise dept bust ethanol smuggling module, 2 nabbed. Hindustan Times. <https://www.hindustantimes.com/cities/chandigarh-news/mohali-police-excise-dept-bust-ethanol-smuggling-module-2-nabbed-101640806826555.html>

⁴⁵ BBC News. (2011, November 25). Leicestershire fake vodka gang jailed. BBC News. <https://www.bbc.com/news/uk-england-leicestershire-15888342>

⁴⁶ European Commission. (2018). Commission Staff Working Document: Impact Assessment Accompanying the document Proposal for a Council Directive amending Directive 92/83/EEC on the harmonization of the structures of excise duties on alcohol and alcoholic beverages [SWD(2018) 259 final]. Brussels: European Commission. <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52018SC0259>

Components of an Ethanol Control Program

As noted by the OECD: *The approach that governments take when governing the production and sale of alcohol can leave the door open for the illicit alcohol market, unintentionally stimulating it.*⁴⁷ To safeguard public health and reduce the risks associated with illicit alcohol, governments should enact and enforce strict laws and regulations governing the trade of ethanol to prevent its diversion for illegal or unauthorized purposes. Key components of an effective ethanol control program include 1) Strong regulatory framework, including mandatory denaturing of ethanol not intended for human consumption; 2) effective enforcement to ensure compliance; and 3) ongoing training and awareness.

Regulatory framework

Effective ethanol control strategies rely on comprehensive legislative and regulatory frameworks that govern the entire ethanol supply chain, whether it originates from domestic production or imports. Well-crafted legislative and regulatory frameworks are vital for achieving the overarching goals of ethanol control programs. These frameworks establish clear guidelines and standards for the production, distribution, and use of ethanol, ensuring transparency, safety, and compliance throughout its journey from source to end-user.

Monitor imports and exports. Given ethanol's critical role in global trade, it is essential that importers and exporters of ethanol register with the appropriate government agencies and adhere to stringent regulations. Only registered and authorized entities should be eligible to import ethanol, or to benefit from any tax incentives. Registration ensures transparency and accountability in the ethanol supply chain, preventing potential misuse and serving as a deterrent to smuggling.

Regulate domestic production and trade. Regulations governing domestic ethanol production should mandate licenses and permits for all individuals or businesses involved in the manufacturing, trade, or use of ethanol, including denatured variants. This regulatory approach ensures compliance with standards and helps prevent unauthorized or unsafe production.

Tracking and Record-Keeping. Once introduced into the market, regulations should establish robust tracking and regulatory mechanisms to foster transparency and accountability in the ethanol supply chain. These measures include stringent record-keeping requirements, such as the quantity, source, destination, and purpose of ethanol shipments, for all businesses or individuals trading in ethanol.⁴⁸ For instance, in the United States, permittees receiving specially denatured spirits must maintain records that include consignor invoices or bill of lading detailing quantities, formula numbers, and container serial numbers, annotated with the date of receipt of the shipment.⁴⁹ These records not only support compliance with

⁴⁷ OECD. (2022). *Illicit Trade in High-Risk Sectors: Implications of Illicit Alcohol for Public Health and Criminal Networks*. Paris: OECD Publishing. <https://doi.org/10.1787/1334c634-en>.

⁴⁸ For example, see labeling requirements in the United States at <https://www.ecfr.gov/current/title-27/section-20.134>

⁴⁹ Code of Federal Regulations, Title 27, Chapter 1, Subchapter A, Part 20, Subpart I, Obtaining Specially Denatured Spirits, §20.163, as of 10/23/2023. [https://www.ecfr.gov/current/title-27/part-20/section-20.163#p-20.163\(d\)](https://www.ecfr.gov/current/title-27/part-20/section-20.163#p-20.163(d))

regulatory standards but also help authorities prevent diversion for illegal or unauthorized purposes.

Criminalize violations. To further strengthen ethanol controls, it is crucial to criminalize any efforts to circumvent legislated ethanol controls, such as tampering with denatured ethanol, making such actions subject to legal consequences.⁵⁰

Penalties for regulatory violations in Taiwan

Regulations Governing Undenatured Ethyl Alcohol.⁵¹ Article 13: A violator of these Regulations shall be subject to penalties pursuant to Article 53 of the Act as follows:

1. Those who fail to register with the municipal government or county/ city competent authority of the location of the business place, in violation of Article 4 hereof, shall be punished by administrative fines.
2. Those who, after importing ethyl alcohol, provide it for purposes inconsistent with the declaration or to a storage site inconsistent with regulations, in violation of Article 6 hereof, shall be punished by administrative fines; if the violator is an ethyl alcohol producer or importer, if the violation is of a material nature or the offender fails to make improvements within a specified period of time following notification to do so, the establishment permit of the offender may be revoked.
3. Those that convert ethyl alcohol back to the undenatured status after the ethyl alcohol was denatured in violation of Article 8 hereof, shall be punished by administrative fines.
4. Those that fail to fill out and file the reports by the deadlines, or file a report containing any false information, or fail to obtain from the purchaser documents evidencing purpose of purchase or documents issued by the competent municipal or county/ city authorities approving the purchase, or fail to keep such documents for two years, in violation of Article 9 or Article 10 hereof, shall be punished by administrative fines. Those that submit a report containing any false information shall, in the first instance, be notified to take corrective measures within a specified time period by the competent authority. For the second violation, an administrative fine shall be imposed. Beginning from the third violation, cumulative administrative fines shall be imposed.

⁵⁰ See for example US Code: § 31.44 Sales of denatured spirits or articles. It is illegal to sell denatured spirits, or any article containing denatured spirits, for beverage purposes. Any person who sells denatured spirits, or any substance or preparation made with or containing denatured spirits, for use, or for sale for use, for beverage purposes, or who sells any such products under circumstances in which it might reasonably appear that it is the intention of the purchaser to procure the same for sale or use for beverage purposes, is subject to the registration and other requirements of this part. Available at <https://www.ecfr.gov/current/title-27/section-31.44>

⁵¹ Regulations Governing Undenatured Ethyl Alcohol, amended 2014-12-26. <https://law.moi.gov.tw/ENG/LawClass/LawAll.aspx?pcode=G0330016>

Denaturing

One of the most successful and cost-effective ethanol control strategies employed by many governments is the requirement that industrial ethanol be "denatured." Denaturing involves the addition of specific toxic and/or unpleasant additives with very bad taste and odor making them unsuitable for human consumption.⁵² Denaturing alcohol does not chemically alter the ethanol molecule. Rather, the ethanol is mixed with other chemicals to form an undrinkable solution.

Denaturing ethanol not only facilitates the legitimate use and production of low-taxed industrial ethanol without the risk of it being repurposed for consumption in alcoholic beverages, but it also ensures compliance with regulatory standards, safeguards tax revenue, and minimizes the possibility of untaxed industrial ethanol infiltrating the alcoholic beverages market.

Moreover, by preventing criminals from diverting lower-cost, untaxed, and potentially harmful industrial ethanol⁵³ to produce counterfeit spirits, denaturing helps close the price gap between illicit and legitimate products, further incentivizing consumers to choose legal alternatives.

Denatured vs undenatured taxation levels

The optimal level of tax differentiation between denatured alcohol and excise-taxed alcohol for consumption depends on various factors, including the objectives of the government, the economic impact, and public health considerations. As a general guideline, tax exemptions or refund programs should be sufficiently attractive to encourage denaturation initiatives.

Similarly, the excise and customs duty applied on imported denatured ethanol should be lower than undenatured (i.e., fit for human consumption) ethyl alcohol. A good example of this is Ghana, where ethyl alcohol has an excise rate of 50%, whereas denatured ethyl alcohol is subject to a significantly lower excise rate of only 10%.⁵⁴ This tax differentiation serves as an incentive for denaturing ethanol that is imported into the country, thereby discouraging its diversion for human consumption. Nevertheless, it's noteworthy that such favorable tax differentials are still uncommon in many countries across the African continent.

Achieving the right balance typically demands continuous evaluation and tax rate adjustments, aligning them with evolving goals and circumstances. Engaging in dialogue with pertinent stakeholders, such as the alcohol industry, public health experts, and tax authorities, can provide valuable insights for shaping and optimizing tax policies to attain desired outcomes.

⁵² In many countries, it is also required that denatured alcohol be dyed blue or purple with an aniline dye. See more under "Labeling and colorants".

⁵³ Ethanol intended for alcoholic beverages must meet specific safety and quality standards for human consumption. In contrast, industrial ethanol is handled in ways that prioritize safety for industrial applications, not human consumption. It may contain impurities or additives that are not safe for ingestion and is frequently taxed at a lower rate to incentivize industrial production.

⁵⁴ Massawudu, L. M. (2023, October 22). How Ghana Passed an Ambitious Alcohol Excise Tax Increase and What Comes Next. Movendi International. <https://movendi.ngo/blog/2023/10/22/how-ghana-passed-an-ambitious-alcohol-excise-tax-increase-and-what-comes-next/> ; pwc. (2023). Ghana: Corporate – Other taxes. n.p.: pwc. <https://taxsummaries.pwc.com/ghana/corporate/other-taxes>

Regulatory oversight

To prevent tax fraud and illicit use, ethanol denaturing processes are usually subject to stringent regulations and rigorous oversight by government agencies.

For example, in the United States the Alcohol and Tobacco Tax and Trade Bureau (TTB) is responsible for enforcing federal regulations related to the production and distribution of ethanol, including denatured ethanol. The TTB issues permits and licenses to alcohol producers, importers, and distributors and establishes guidelines and approves formulas for denaturing agents to ensure compliance with the law. The implementation of robust licensing procedures, regular inspections, and comprehensive record-keeping requirements enables monitoring and tracing of legitimate production and distribution of denatured alcohol.

In the European Union, Directive 92/83/EEC (Article 27)⁵⁵ mandates that alcohol not intended for human consumption must be denatured in accordance with national-level requirements to qualify for an excise duty exemption. EU member states' national authorities are responsible for enforcing regulations pertaining to denatured ethanol. They oversee the implementation and compliance with denaturing rules, ensuring adherence to established regulations. One such regulatory measure, EU Directive 2008/118/EC (Article 15(2))⁵⁶, requires that the production, processing, and storage of excise goods without paid excise duty must occur in tax warehouses. Consequently, denaturation processes within the EU must occur in tax warehouses to facilitate proper oversight and prevent the unauthorized release and sale of untaxed alcohol for consumption.

Labeling and colorants

Additional control measures involve requirements for labeling and color marking to clearly differentiate it from consumable alcohol. For example, pharmacy alcohol⁵⁷ and denatured alcohol might be dyed blue, purple, or another color that is readily identifiable. Additionally, specific indicators, such as unique packaging and warning labels, are employed to enhance the recognizability of denatured alcohol. These measures clearly inform consumers and distributors that the alcohol is unsuitable for human consumption. Additionally, these visual cues help law enforcement agencies and regulatory authorities in identifying and distinguishing between denatured alcohol and consumable alcohol during inspections, investigations, and enforcement activities.

⁵⁵ European Council. (1992). Council Directive 92/83/EEC of 19 October 1992 on the harmonization of the structures of excise duties on alcohol and alcoholic beverages. Official Journal L 316 , 31/10/1992, P. 0021 – 0027. Luxembourg: European Council. <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31992L0083:en:HTML>

⁵⁶ European Council. (2008). Council Directive 2008/118/EC of 16 December 2008 concerning the general arrangements for excise duty and repealing Directive 92/12/EEC. Official Journal of the European Union L 9/30, 14/1/2009, P. 12-30. Brussels: European Council. <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:009:0012:0030:EN:PDF>

⁵⁷ Pharmacy alcohol, also known as medicinal alcohol or pharmaceutical-grade ethanol, refers to alcohol products that are manufactured and sold for medical, scientific, or industrial purposes. These alcohol products are typically of high purity and are used in various applications, including as a solvent in the pharmaceutical and cosmetic industries, as an antiseptic for disinfection, in laboratory settings for scientific research, and for compounding medicines in pharmacies. Pharmacy alcohol is often denatured to make it unsuitable for consumption to prevent misuse. However, in some countries pharmacy alcohol is not denatured, rendering its sale and use particularly susceptible to the production of illicit alcoholic beverages.

Denatured Alcohol

DANGER
Highly flammable liquid and vapor. Causes serious eye irritation. May cause drowsiness or dizziness.

PREVENTION
Keep away from heat, sparks, and open flames. — No smoking. Keep container tightly closed.
Avoid breathing vapors. Use only outdoors or in a well-ventilated area. Wear eye protection.

RESPONSE
If inhaled: Remove person to fresh air and keep comfortable for breathing. Call a doctor if you feel unwell.
If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists: get medical attention.
In case of fire: Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide for extinction.

COMPLETELY DENATURED ALCOHOL 87
ETHYL ALCOHOL % BY VOLUME
NOT FOR INTERNAL OR EXTERNAL USE ON MAN OR ANIMAL

To Be Used For Art, Mechanical and Burning Purposes Only
Completely Denatured Alcohol is a violent poison. It cannot be applied externally to human or animal tissue without serious injurious results. It cannot be taken internally without inducing blindness and general physical decay, ultimately resulting in death.

POISON

ANTIDOTE: Empty stomach immediately with large quantity luke-warm water, then drink copiously of sweet milk or strong coffee; inhale ammonia. Call Physician.
Inflammable—Keep away from Fire and Flame.

CONTENTS FL. OZS. PACKED BY



Warning labels, dye and markings make denatured alcohol easily recognizable and clearly inform consumers and distributors that the alcohol is unsuitable for human consumption.

Denaturant formulations

There is no ISO standard or similar international definition of denaturants or denatured alcohol. This absence can be attributed to a variety of factors, including historical practices, diverse legal regulations, and a desire for autonomy in addressing public safety and health concerns. Consequently, regulations for denatured alcohol differ from one country to another, with each nation having its own specific denaturation requirements and formulations.

The closest international approximation can be found in the international Harmonized System (HS) under heading 2207: “Undenatured ethyl alcohol of an alcoholic strength by volume of 80% vol. or higher; ethyl alcohol and other spirits, denatured, of any strength.”⁵⁸

⁵⁸ A Harmonized System (HS) code, also known as a Harmonized Commodity Description and Coding System, is a standardized international system used to classify and categorize products for customs and trade purposes. The HS code is a numerical code that represents a specific product, providing a common language for governments, businesses, and customs authorities worldwide to identify and classify goods consistently.

The HS code system was developed and is maintained by the World Customs Organization (WCO).

The WCO explanatory notes to heading 2207⁵⁹ state that: *'Ethyl alcohol and other spirits, denatured, are spirits mixed with substances to render them unfit for drinking but not to prevent their use for industrial purposes. The denaturants used vary in different countries according to national legislation. They include wood naphtha, methanol, acetone, pyridine, aromatic hydrocarbons (benzene etc.), colouring matter.'*⁶⁰

Historically, methanol was the primary denaturant because of its toxicity (making it unfit for oral consumption). Moreover, with a boiling point close to that of ethanol, it is difficult to separate the two by simple distillation. Consequently, the term "methylated alcohol" is often interchangeably used for denatured alcohol, even though methanol is now rarely used as a denaturant.⁶¹

Over time other denaturants have been developed, with the aim to balance specific industrial needs with potential health hazards. For instance, in New Zealand, methanol was once a commonly used denaturant. However, due to its significant health risks, it was officially removed from the government-approved denaturant list for products intended for sale to the public in 2006.⁶² In Mexico, regulations require that ethanol be completely devoid of methanol to qualify as denatured.⁶³

Regulatory agencies responsible for overseeing the production and distribution of denatured ethanol normally maintain and update lists of approved denaturants and related regulations. The specific agencies involved can vary from country to country and may encompass customs authorities, health departments, or alcohol and beverage control boards, depending on the jurisdiction.

In Sweden, the Public Health Agency (Folkhälsomyndigheten) regulates the use and handling of denatured alcohol. They set rules regarding the types of denaturants that can be used and their concentrations to render alcohol unfit for consumption while allowing for safe industrial use.⁶⁴

In Ecuador, the General Directorate of Revenues within the Ministry of Economy and Finance (known as "la Dirección General de Ingresos del Ministerio de Hacienda y Tesoro") is tasked with regulating the utilization of denaturants, specifying their chemical formulations,

⁵⁹ World Customs Organization. (2012). Harmonized System Explanatory Notes 2012 Edition. Brussels : World Customs Organization. p. 191 http://harmonizedsystem.wcoomdpublishings.org/pdfs/WCOOMD_NE_AS1_EN.pdf

⁶⁰ European Parliament. (2006). Answer given by Mr Kovács on behalf of the Commission. n.p.: European Parliament. https://www.europarl.europa.eu/doceo/document/E-6-2005-4413-ASW_IT.html?redirect

⁶¹ Lachenmeier, D.W., Rehm, J. and Gmel, G. (2007). Surrogate Alcohol: What Do We Know and Where Do We Go?. *Alcoholism: Clinical and Experimental Research*, 31, 1613-1624. <https://doi.org/10.1111/j.1530-0277.2007.00474.x>

⁶² For goods not targeted at the public, such as those for industrial use, the use of methanol as a denaturant is subject to specific volume restrictions, falling within the range of at least 1.5% but no more than 2% by volume. Environmental Protection Authority. (2020). Denatured Ethanol Group Standard 2020. Wellington: New Zealand Government. <https://www.epa.govt.nz/assets/RecordsAPI/Denatured-Ethanol-Group-Standard-2020-HSR002553.pdf>

⁶³ Government of Mexico. (1997). Official Mexican Standard NOM-138-SSA1-1995. Acapulco: Secretariat of Health. <http://www.ordenjuridico.gob.mx/Documentos/Federal/wo69549.pdf>

⁶⁴ Folkhälsomyndigheten. (2023). Teknisk sprit och alkoholhaltiga preparat. Solna/Östersund: Folkhälsomyndigheten. <https://www.folkhalsomyndigheten.se/livsvillkor-levnadsvanor/andts/regler-for-tillverkning-handel-och-hantering/teknisk-sprit-och-alkoholhaltiga-preparat/>; Folkhälsomyndigheten. (2023). Vägledning för handel med teknisk sprit och alkoholhaltiga preparat. Solna/Östersund: Folkhälsomyndigheten. <https://www.folkhalsomyndigheten.se/publikationer-och-material/publikationsarkiv/v/vagledning-for-handel-med-teknisk-sprit-och-alkoholhaltiga-preparat>

designating individuals responsible for the denaturation process, and implementing additional measures for its oversight and enforcement.⁶⁵

The selection of denaturants and their respective formulations can vary significantly from one jurisdiction to another. For instance, in Mexico⁶⁶, regulations allow for the use of four types of denaturants. In Singapore,⁶⁷ they recognize 14 denaturants at specific concentrations to qualify as denatured ethyl alcohol. Australia⁶⁸ has approved 20 denaturants, each with specified minimum concentration requirements. In contrast, the United States⁶⁹ maintains an extensive list comprising over 200 denaturants, distributed across more than 40 approved denaturation formulas.

Despite these variations, Denatonium benzoate, also known as Bitrex®, is a widely used non-toxic denaturant.⁷⁰ Bitrex is highly effective due to its extreme bitterness, which can cause nausea and vomiting if ingested. It's utilized in over 40 countries and favored for its cost-effectiveness and ease of use.⁷¹ Other common additives include isopropyl alcohol, acetone, methyl ethyl ketone, and methyl isobutyl ketone.

For a list of some of the most common denaturants and examples of approved country formulations, see [annex 1-2](#).

Completely denatured alcohol vs Partially denatured/Special denatured

Regulations may delineate special classes of denaturing to account for products not intended for human consumption but for which the rules on completely denatured alcohol (CDA) are not suitable. For example, industrial ethanol for use in perfumes cannot be too heavily denatured.⁷² These classes are commonly known as Special Denatured Alcohol (SDA), Partially Denatured (PD) or Trade-Specific Alcohol (TSA), and their utilization is typically restricted to specific authorized purposes/products.

For example, in the EU, the term 'partially denatured alcohol' refers to alcohol that is denatured with only one denaturant or a different mix of denaturants than the standard EURO CDA denaturing formula. Similarly, in the UK, Trade-Specific denatured alcohol is a type of denatured alcohol

⁶⁵ República de Panamá. (1998). Por El Cual Se Reglamenta La Ley N°2 De 13 De Enero De 1998, En El Cual Se Regulan Los Procesos De Elaboracion, Almacenamiento Y Despacho De Alcoholes. Panama City: Ministerio de Hacienda y Tesoro.

<https://docs.panama.iustia.com/federales/decretos-ejecutivos/105-de-1998-aug-4-1998.pdf>

⁶⁶ Government of Mexico. (1997). Official Mexican Standard NOM-138-SSA1-1995. Acapulco: Secretariat of Health.

<http://www.ordenjuridico.gob.mx/Documentos/Federal/wo69549.pdf>

⁶⁷ Singapore Customs. (n.d.). Importing Ethyl Alcohol. Singapore: Singapore Customs. <https://www.customs.gov.sg/businesses/importing-goods/import-procedures/importing-ethyl-alcohol/>

⁶⁸ Australian Taxation Office. (2016). Excise (Denatured spirits) Determination 2016 (No. 3). Canberra: Australian Government.

<https://www.ato.gov.au/law/view/document?DocID=ELD/ED201610/00001&PiT=99991231235958>

⁶⁹ Code of Federal Regulations Title 27, Chapter I, Subchapter I, Part 21, up to date as of 10/23/2023. <https://www.ecfr.gov/current/title-27/chapter-I/subchapter-A/part-21?toc=1>

⁷⁰ Bitrex. (2023). What is Bitrex?. Edinburgh: Bitrex. <https://www.bitrex.com/what-is-bitrex/>

⁷¹ Kwiatkowski, A., Czerwicka, M. Smulko, J. & Stepnowski, P. (2014). Detection of Denatonium Benzoate (Bitrex) Remnants in Noncommercial Alcoholic Beverages by Raman Spectroscopy. *Journal of Forensic Sciences*. 59 (5). 1358-63.

<https://pubmed.ncbi.nlm.nih.gov/24661259/>

⁷² Approx. EUR 3-3.5 billion worth of denatured alcohol is used annually in the EU for a variety of industrial purposes. It is estimated that more than 95% of the total consumption is PDA, although CDA accounts for a significant share of the market in certain Member States and sectors. European Commission. (2018). Commission Staff Working Document Impact Assessment Accompanying the document Proposal for a Council Directive amending Directive 92/83/EEC on the harmonization of the structures of excise duties on alcohol and alcoholic beverages [SWD(2018) 259 final]. Brussels: European Commission. <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52018SC0259>

approved to meet specific trade needs that cannot contain regular denaturants which may damage skin (perfumes / deodorants) or the environment (e.g., screen wash).

The sale and use of SDA often entails stricter record-keeping and reporting obligations imposed on both buyers and sellers to ensure that the alcohol serves its intended purpose and to prevent unauthorized consumption.⁷³

Mutual recognition of denaturation

Given ethanol's use across many diverse sectors, variations in national denaturant formulas can create trade impediments. What qualifies as denatured ethanol in country A might be classified as excise-taxed alcohol in country B, if the latter doesn't recognize or accept the denaturant formula used by the former. To avoid this, legislation may provide for the mutual recognition of other countries' denaturation procedures.

In the EU, Commission Regulation (EC) 3199/93⁷⁴, last amended by Commission Implementing Regulation (EU) 2018/1880 (published in the OJ on 30th November 2018),⁷⁵ enables mutual recognition of Member States' alcohol denaturation procedures. This ensures that alcohol which has been completely denatured in one Member State, according to any of the "Euro" formulations⁷⁶ or approved national procedures, is recognized as completely denatured alcohol when it is moved to another Member State. As such, it remains exempt from excise duties, regardless of where it is transported within the EU.

The "Euro" completely denatured alcohol (CDA) formulation:⁷⁷

Per HL of absolute alcohol:

- 1L methyl ethyl ketone (a smelling agent)
- 1L isopropyl alcohol (a chemical analytical marker)
- 1gr denatonium benzoate (a tasting agent)

In a few Member States, there are varying combinations of the quantities of two of the three chemical agents, but all three chemical agents are present in all the Member States' "Euro" formulations for CDA.

⁷³ Alcohol and Tobacco Tax and Trade Bureau. (2021). Denatured Alcohol. Washington, DC: US Department of the Treasury. <https://www.ttb.gov/industrial/industrial-alcohol-denatured-alcohol>

⁷⁴ European Commission. (2018). Commission Regulation (EC) No 3199/93 of 22 November 1993 on the mutual recognition of procedures for the complete denaturing of alcohol for the purposes of exemption from excise duty. n.p.: European Commission. <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A01993R3199-20130701>

⁷⁵ European Commission. (2018). Commission Implementing Regulation (EU) 2018/1880 of 30 November 2018 amending Regulation (EC) No 3199/93 on the mutual recognition of procedures for the complete denaturing of alcohol for the purposes of exemption from excise duty. Official Journal of the European Union, L 307, 24-26. <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32018R1880>

⁷⁶ The EURO formula is per HL of absolute alcohol: 1L methyl ethyl ketone (a smelling agent); 1L isopropyl alcohol (a chemical analytical marker); 1gr denatonium benzoate (a tasting agent). In a few Member States, there are varying combinations of the quantities of two of the three chemical agents, but all three chemical agents are present in all of the Member States "Euro" formulations for CDA. Member States can still maintain their own national denaturing formulations for CDA, which must then be notified and authorised at EU level.

⁷⁷ European Commission. (n.d.). Denatured Alcohol Not For Human Consumption. n.p.: European Commission. https://taxation-customs.ec.europa.eu/denatured-alcohol-not-human-consumption_en

Enforcement

To enforce ethanol regulations, governments employ a range of measures, including inspections, testing protocols, and audits of record-keeping. These efforts aim to monitor and maintain compliance with established standards throughout the ethanol supply chain, from production facilities to distributors and end-users. By conducting regular inspections, verifying the quality and safety of ethanol, and scrutinizing records, authorities can effectively safeguard public health, protect tax revenue, and deter illegal or unauthorized activities related to ethanol trade and usage. These enforcement activities play a critical role in upholding the integrity of ethanol control measures and ensuring the responsible handling of this versatile substance in various industries.

Routine inspections and testing prevent misuse, maintain safety standards, and fulfill regulatory mandates. Enforcement bodies should have convenient access to laboratories for the precise identification of denatured ethanol. Ideally this should include mobile units/labs that enable flexibility, speed and efficiency in testing procedures. In Colombia, (see [Colombia case study](#)) a compact mobile laboratory (infrared spectrophotometer) was located at the Buenaventura Port, a key entry point for ethanol imports. The technical ability of the lab to quickly identify denatured ethanol—along with publicity—led to swift and significant reductions in illicit ethanol trafficking through the port. Testing is particularly important in cases where denatured ethanol will have human contact, such as alcohol use in cosmetics, pharmaceuticals or foodstuffs, to ensure that toxicity levels are below approved thresholds.

Stringent record-keeping requirements throughout the ethanol supply chain enhance the monitoring of legitimate (denatured) ethanol production and distribution. Any unaccounted alcohol losses trigger fines for the involved parties and possible repayment of “avoided” excise payments.

Promoting interagency cooperation and information sharing is vital for effective oversight. Given ethanol's wide range of applications, multiple government agencies, including customs authorities, public health, food safety, police, and alcohol and beverage control boards, need to be involved in regulatory oversight and enforcement.

Vigilant monitoring of border crossings, led by Customs authorities, is critical for deterring ethanol smuggling. Legal ethanol imports adhere to national denaturant requirements to qualify for preferential tax treatment, such as reduced duties and excise tax exemptions. In anticipation of increasing imports of illicit or otherwise unregulated ethanol, Customs and regulatory agencies should employ advanced testing and authentication methods to verify the authenticity and compliance of imported (including denatured) ethanol.

Penalties for violations typically include fines, license revocation, and criminal charges. For example, in the United States, violations of denaturing rules are punishable by a fine of USD 10,000 and/or imprisonment for up to 5 years. In addition, persons who manufacture, sell, or

transport ethanol in violation of regulations are liable for payment of a tax on the articles at the rate imposed by law on distilled spirits.⁷⁸

By closely scrutinizing the ethanol supply chain, authorities can achieve several critical objectives:

- Evaluate the effectiveness of the denaturing program.
- Detect and address any illicit activities related to denatured ethanol.
- Determine the scale of ethanol smuggling.
- Make necessary adaptations and reinforce enforcement strategies.

This proactive approach not only upholds the integrity of the supply chain for denatured alcohol, but also safeguards public health and preserves government revenues.

Application of Track and Trace programs

Molecular marking programs utilized to monitor certain government fuel initiatives aimed at preventing theft, tax evasion, and smuggling of petroleum products could have merit in monitoring ethanol denaturization programs. However, the prospect of implementing molecular markers for ethanol similar to those used in fuel marking faces significant challenges:

Diverse End Uses: Ethanol and fuel serve distinct purposes and are subject to different regulatory frameworks. Fuel marking and tracking systems primarily aim to combat tax evasion and ensure adherence to environmental and safety standards within a single sector (the fuel industry). In stark contrast, ethanol finds application across a range of industries, including pharmaceuticals, cosmetics, chemicals, and more. Each of these sectors has its own regulations and quality prerequisites, making the development of a standardized marking system complex.

Cost and Feasibility: Developing and implementing a marker system for ethanol would require substantial financial resources and coordination among government agencies, industry stakeholders, and technology providers. Given that industrial ethanol is mixed with gasoline to produce ethanol-blended fuels and may also come in direct contact with consumers through various applications, (e.g., ingestion when used in pharmaceuticals or topical application in cosmetics), the introduction of a new additive would necessitate rigorous testing and scrutiny by government agencies. In the United States, this regulatory oversight would likely involve at least the FDA (Food and Drug Administration), ATF (Bureau of Alcohol, Tobacco, Firearms and Explosives) and the EPA (Environmental Protection Agency). This process would likely increase costs and complexities, and it is also likely that industry would be asked to bear some (or all of the cost) for these programs, similar to tax stamps.

⁷⁸ See § 20.137 Penalties at <https://www.ecfr.gov/current/title-27/section-20.137>

Case Study: Reducing the Diversion of Industrial Ethanol through Denaturing Legislation and Improved Testing in Colombia

Background

Colombia is heavily reliant on imported ethanol for its various industrial needs, with 94 percent of ethanol consumed in Colombia sourced from international markets.

Market Liberalization and Diversion Challenge

In 2001, Colombia abolished the provincial monopoly on non-potable ethanol and fully liberalized the ethanol market. While this change brought about greater flexibility in importing ethanol, the new open market also inadvertently facilitated the diversion of industrial ethanol to produce illicit counterfeit spirits.

Recognizing the need of to address this issue and safeguard public health, the Colombian government introduced the *Spirits Bill* in 2016. Key provisions included:

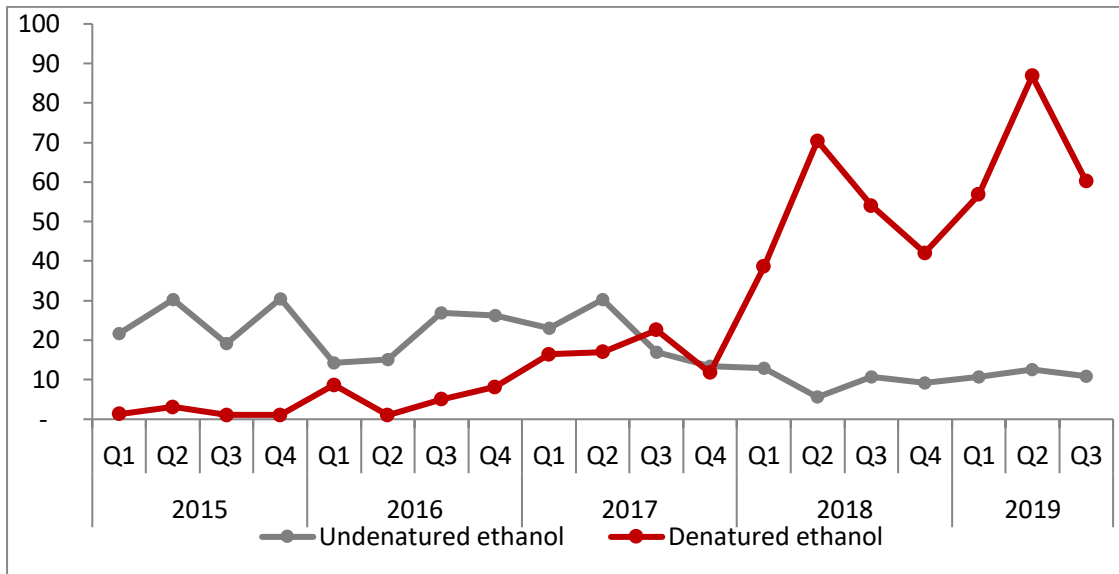
1. Mandating the denaturation of all ethanol not intended for human consumption.
2. Conferring authority to individual agencies to establish a Register for monitoring distributors, importers, and producers involved in the ethanol trade. This allowed for better tracking and control over the supply chain.
3. Installation of a compact and mobile laboratory (infrared spectrophotometer) for the precise identification of denatured ethanol. This mobile laboratory was strategically located outside the Buenaventura Port, a key entry point for ethanol imports into Colombia. The mobile laboratory was donated to the government by local brewery Bavaria, underscoring the role that public private partnerships (PPPs) can play in tackling illicit alcohol.



Outcomes

The implementation of these regulatory changes yielded several positive outcomes:

- Increased Importation of Denatured Ethanol: The enforcement of denaturing legislation led to a significant uptick in the importation of denatured ethanol, as it became the standard for non-potable industrial uses.
- Reduced Price Gap between Licit and Illicit Alcohol: The reduction in illicit ethanol in the market stripped counterfeiters of low-cost supply, narrowing the price gap between legitimate and counterfeit alcoholic beverages.



This case study demonstrates the positive impact of well-designed, rigorously enforced denaturing legislation. The combination of robust legislation, effective enforcement measures, and strategic positioning of enforcement resources proved to be a success in reducing the prevalence of counterfeit spirits and ensuring safer consumption practices for its citizens.

Addressing denaturing challenges

While denatured ethanol is not a guaranteed solution for eliminating illicit trade in alcohol, it has been proven to be effective in reducing its prevalence in two ways: (i) by making the product unattractive for consumption and distinguishing it from legal alcohol, (ii) by eliminating criminals' access to inexpensive illegal ethanol, thereby closing the price gap between illicit and legitimate products.

Nonetheless, consideration must be given to mitigating fraud and ensuring consumer safety:

- Ensuring Consumer Safety:** Given the possibility of criminal attempts to use denatured alcohol for illicit beverages or its deliberate consumption as surrogate alcohol, it is important that denaturing programs consider consumer safety. This may require minimizing the use of highly toxic agents, such as methanol, whenever possible. Alternative denaturing agents that are non-toxic, such as Denatonium benzoate (Bitrex), or have less severe health effects, such as isopropanol, should be considered wherever feasible.
- Reversing or disguising denatured ethanol.** Another health and safety risk can occur when criminals attempt to reverse denatured ethanol. This is a difficult and costly process because once denaturants are added to ethanol, they cannot be easily removed or reversed. Reversal is typically illegal in most countries. A bigger concern is when criminals dilute or disguise denaturing so that it looks like or tastes like pure

ethanol, but still contains residual toxins that can be highly harmful or even lethal if consumed.

- **Mitigating Fraud:** One way to redirect industrial ethanol to the production of illicit alcoholic beverages is to falsely claim that it has been denatured. To address this challenge, it is essential to establish and maintain consistent regulatory compliance, testing, and record-keeping practices throughout the denaturation process. Effective enforcement mechanisms should be in place, including regular inspections and close collaboration between regulatory authorities and law enforcement agencies, to ensure strict adherence to denaturation regulations.

Training and Awareness

The sustainability of an effective ethanol control program depends on training and awareness-building initiatives to educate industry stakeholders, enforcement agencies and consumers about the denaturation process, safety protocols, and the significance of regulatory compliance. A crucial element of this is educating stakeholders on the risks associated with consuming illegal alcohol despite how inexpensive it is.

Implement regular training programs for law enforcement officers, regulatory agencies and Customs personnel, equipping them with the necessary knowledge and skills to enforce ethanol control regulations effectively. Consideration should be given to joint training opportunities and exercises between regulators and enforcement, industry stakeholders, and relevant parties to leverage the private sector's expertise and encourage a culture of mutual support.

Develop technical guidance and compliance checklists for public use, clearly outlining the requirements for compliance with ethanol control regulations at each stage of the process (i.e., import control, local production and denaturization). These guidance materials can enhance regulatory adherence by establishing expectations for all stakeholders engaged in the denaturation process.⁷⁹

A good example is the Public Health Agency of Sweden publication on the “Guidance for trade in technical spirits and alcoholic preparations.” The publication is intended for those who trade in denatured alcohol or alcoholic products. It provides information on alcohol legislation, the rules governing trade in denatured alcohol and alcoholic products, and the responsibilities of business operators. The publication offers guidance on determining what constitutes denatured alcohol and alcoholic products, and when approval from the Swedish Tax Agency is required to initiate trading. The guidance includes information on the rules for denaturing ethanol and alcoholic products. The publication also explains the role of the Public Health Agency of Sweden as the supervisory authority.⁸⁰

⁷⁹ Folkhälsomyndigheten. (2023). Vägledning för handel med teknisk sprit och alkoholhaltiga preparat. Solna/Östersund: Folkhälsomyndigheten. <https://www.folkhalsomyndigheten.se/publikationer-och-material/publikationsarkiv/v/vagledning-for-handel-med-teknisk-sprit-och-alkoholhaltiga-preparat/?pub=120389>

⁸⁰ Folkhälsomyndigheten. (2023). Vägledning för handel med teknisk sprit och alkoholhaltiga preparat. Solna/Östersund: Folkhälsomyndigheten. <https://www.folkhalsomyndigheten.se/publikationer-och-material/publikationsarkiv/v/vagledning-for-handel-med-teknisk-sprit-och-alkoholhaltiga-preparat/?pub=120389>

Organize awareness campaigns that emphasize the risks associated with consumption of illicit alcohol and underscore the critical role of ethanol control programs, especially denaturation, in protecting public health.

Establish reporting systems and routines where incidents or concerns related to ethanol control, especially denatured ethanol, can be promptly reported and addressed. Timely reporting enables regulatory authorities to swiftly investigate and respond to potential breaches, ensuring the continued effectiveness of ethanol control measures.

Promote stakeholder dialogue with government, key producers and affected parties, to raise awareness and provide greater clarity for enforcement agencies. This includes establishing a permanent ethanol control dialogue / board between government, key producers and affected parties. Successful ethanol control strategies in the United States, European Commission and UK include regular dialogue and consultations with industry to ensure the continuous improvement and alignment of regulatory practices, fostering a more robust and cooperative approach to ethanol control for the benefit of public safety and industry integrity. Public-private partnerships can play a vital role in disseminating information and promoting responsible consumption practices.

Develop Key Performance Indicators (KPIs) for evaluating the effectiveness of ethanol control regulations. Monitoring and analyzing KPIs can play an important role in evaluating the effectiveness of ethanol control programs. They provide valuable insights into compliance, enforcement, and the overall impact of regulatory efforts. Examples of KPIs include:

- **Regulatory Adherence:** Monitoring changes in the number of businesses and individuals holding permits or licenses for ethanol-related activities over time helps authorities understand the scope of the market and identify areas that require closer attention.
- **Incident Rates and Enforcement Outcomes:** Measuring the frequency of non-compliance incidents and the subsequent actions taken in response, including fines, license revocations, legal actions, or imposed penalties assists decision-makers in evaluating the effectiveness of enforcement measures and refining regulatory strategies.
- **Annual Volume of Traded Ethanol:** Measuring the total annual volume of ethanol traded, including denatured, provides valuable information about market size, growth or contraction. Comparing this data with other metrics like permits, export/import volumes, revenue, and seizures helps regulators assess the overall effectiveness of a denaturation program.
- **Revenue collection:** Measuring the amount of excise tax revenue collected over time provides quantifiable data on the fiscal impact of ethanol control and denaturing efforts.
- **Border Seizures:** The volume and frequency of ethanol seizures at border crossings reflect the efficiency of border monitoring and can reveal trends in smuggling activities.

Annexes

Annex 1: Common Denaturants

There are several types of denaturants used in ethanol, each with its own properties and applications. Some of the most common denaturant additives include:⁸¹

Isopropanol	Also known as isopropyl alcohol or IPA, isopropanol is a colorless, flammable liquid that is used as a denaturant for ethanol. Isopropanol is toxic when consumed and produces unpleasant effects. Adding even small amounts (3%, 5%, or 10% of the total mixture) renders the ethanol unfit for consumption. Being less toxic than methanol, isopropanol is often used in personal care products.
Methyl ethyl ketone	Methyl ethyl ketone, or MEK, is a colorless, flammable liquid solvent that can be used to denature alcohol. It has a strong odor and an unpleasant taste, making the alcohol unpalatable. A small amount - usually 1% - makes the ethanol unfit for consumption.
Denatonium benzoate	Denatonium benzoate, better known as Bitrex, is a bitter-tasting chemical that is often added to denature alcohol. It ranks among the most intensely bitter substances known and serves as a highly efficient deterrent against consumption. While Bitrex is non-toxic, its extreme bitterness can induce nausea and vomiting if ingested. Its low cost, effectiveness and ease of use explains its widespread application as a denaturant.
Diethyl phthalate	Diethyl phthalate (DEP) is a colorless, odorless liquid with a bitter, disagreeable taste
Tertiary butyl alcohol	Tertiary butyl alcohol, or TBA, is a commonly used ethanol denaturant. It is a clear, colorless, highly flammable liquid with a strong odor. The key benefit of TBA is its low boiling point, water-soluble properties and being less toxic than many other denaturants.
Methanol	Methanol (methyl alcohol or Wood Alcohol): Adding methanol to ethanol is another common method of denaturing alcohol. Methanol is a colorless, flammable, highly toxic liquid that can cause blindness or even death if ingested. The boiling point of methanol is very close to that of ethanol, making it difficult to separate the two by simple distillation. Adding only 5% of the total amount to ethanol renders it unfit for human consumption. Although the formulation of denatured ethanol has shifted towards safer denaturants like denatonium benzoate, formulations containing methanol are common. ^{82, 83}

⁸¹ Nedstar. (2023). Understanding denatured alcohol. Amsterdam: Nedstar. <https://www.nedstar.com/blog/understanding-denatured-alcohol>

⁸² Particularly in the case of some trade-specific formulations, see for example TSDA Formulas #4 and #9 in the UK. HM Revenue & Customs. (2023). *Production, distribution and use of denatured alcohol (Excise Notice 473)*. n.p.: HM Revenue & Customs. <https://www.gov.uk/government/publications/excise-notice-473-production-distribution-and-use-of-denatured-alcohol/excise-notice-473-production-distribution-and-use-of-denatured-alcohol>

⁸³ Robed Amin, M., Shohagh, A.S., Basher, A., Rahman, M., Abul Faiz, M. & Ahasan, H.N. (2017). Methanol Poisoning with Fatality - Case Series in Dhaka Medical College Hospital in Bangladesh. *Toxicol Open Access*, 3(1), 121-124.

Annex 2: Country examples of accepted denaturants and their required concentrations

Singapore⁸⁴

	Denaturant(s) and concentration
1	5% (v/v) methyl alcohol/cyclohexane
2	5% (v/v) isopropyl alcohol
3	5% (v/v) chloroform
4	0.125% (v/v) tert-butyl alcohol and 0.0005% (w/v) denatonium benzoate (Bitrex)
5	5% (v/v) toluene
6	1% (v/v) diethyl phthalate
7	4.25% (v/v) ethyl acetate having ester content of 100% by weight
8	50ppm (w/v) aqueous nicotine and 0.7ppm (w/v) methylene blue
9	4% (v/v) methyl alcohol and 0.0009% (w/v) denatonium benzoate (Bitrex)
10	4% (v/v) methyl n-butyl ketone/methyl isobutyl ketone and 1% kerosene/gasoline/unleaded gasoline/heptane
11	2% (v/v) methyl ethyl ketone/acetone and 3 % (v/v) methyl isobutyl ketone
12	0.12% (w/v) of sucrose octaacetate and 0.125% (v/v) of tert-butyl alcohol
13	5% (v/v) of ethyl ether
14	1.0% (v/v) of 100 percent acetaldehyde

⁸⁴ Singapore Customs. (n.d.). Importing Ethyl Alcohol. Singapore: Singapore Customs. <https://www.customs.gov.sg/businesses/importing-goods/import-procedures/importing-ethyl-alcohol/>

Australia⁸⁵

	Denaturant	CAS registry number	Minimum concentration for 100% ethanol
1	acetaldehyde	75-07-0	1.0% v/v
2	n-propanol	71-23-8	1.0% v/v
3	n-propyl acetate	109-60-4	1.0% v/v
4	acetone	67-64-1	2.0% v/v
5	denatonium benzoate	3734-33-6	5 ppm
6	ethyl acetate	141-78-6	1.0% v/v
7	propylene glycol mono-methyl ether	107-98-2	1.0% v/v
8	sodium nitrite	7632-00-0	0.25% v/v
9	methyl ethyl ketone	78-93-3	0.5% v/v
10	methoxy propyl acetate	108-65-6	0.5% v/v
11	methanol	67-56-1	5.0% v/v
12	isopropanol	67-63-0	5.0% v/v
13	tertiary butyl alcohol	75-65-0	0.25% v/v
14	methyl isobutyl ketone	108-10-1	0.25% v/v
15	n-hexane	110-54-3	1.0% v/v
16	ethyl ether	60-29-7	1.0% v/v

⁸⁵ Australian Taxation Office. (2016). Excise (Denatured spirits) Determination 2016 (No. 3). Canberra: Australian Government. <https://www.ato.gov.au/law/view/document?DocID=ELD/ED201610/00001&PiT=99991231235958>

17	propylene glycol	57-55-6	20.0% v/v
18	sodium hydroxide	1310-73-2	0.25% w/w
19	sodium molybdate	7631-95-0	0.25% w/w
20	sodium tolytriazole	64665-57-2	0.25% w/w

Mexico⁸⁶

Formula I.

Per 1000 dm³ (L) of ethyl alcohol at 68.5 to 71.5% v/v at 288.56 K (15.56°C).

- 7g denatonium benzoate.

Formula II.

1000 dm³ (L) of ethyl alcohol at 68.5 to 71.5% v/v at 288.56 K (15.56°C).

- 300 g of sucrose octaacetate.

Formula III.

1000 dm³ (L) of ethyl alcohol at 68.5 to 71.5% v/v at 288.56 K (15.56°C).

- 80 dm³ (L) of acetone.
- 15 dm³ (L) of methyl isobutyl ketone.

Mexican regulation requires that ethanol must be completely devoid of methanol to qualify as denatured.

Taiwan⁸⁷

Appendix: Standard Chart of Ethyl Alcohol Denaturant

Item	The quantity of denaturant added into the alcohol per kiloliter (The standard of alcohol content is 95% by volume)	
1	Pine tar Ch.P or USP	≧10 kiloliter
2	Toluol CNS	≧50 kiloliter
3	Ethyl ether CNS or Ch.P	≧100 kiloliter
4	Lavender oil CNS or Ch.P	≧10 kiloliter
	Medicinal soft soap or Ch.P	≧100 kilogram
5	Strong ammonia water CNS or Ch.P	≧30 kiloliter
6	5% of water solution of zinc chloride	≧50 kiloliter

⁸⁶ Government of Mexico. (1997). Official Mexican Standard NOM-138-SSA1-1995. Acapulco: Secretariat of Health.
<http://www.ordenjuridico.gob.mx/Documentos/Federal/wo69549.pdf>

⁸⁷ Regulations Governing Undenatured Ethyl Alcohol, amended 2014-12-26.
<https://law.moi.gov.tw/ENG/LawClass/LawAll.aspx?pcode=G0330016>

	Any kind of the following items, either one or more:	≥ 10 kiloliter
	(1) Cinnamon oil; Cassia oil CNS or Ch.P	
	(2) Clove oil CNS or Ch.P	
	(3) Peppermint oil CNS or Ch.P	
	Note: The oil listed above must be dissolved into alcohol before added into zinc chloride.	
7	Any kind of the following items, either one or more:	≥ 10 kilogram
	(1) Anethole Ch.P	
	(2) Anise oil CNS or Ch.P	
	(3) Bay oil CNS	
	(4) Bergamot oil CNS or N.F	
	(5) Bitter almond oil Ch.P	
	(6) Cedar leaf oil USP	
	(7) Chlorothymol N.F	
	(8) Cinnamon oil; Cassia oil CNS or Ch.P	
	(9) Citronella oil, natural CNS	
	(10) Eucalyptus oil CNS or Ch.P	
	(11) Guaiacol Ch.P	
	(12) Lavender oil CNS or Ch.P	
	(13) Peppermint oil CNS or Ch.P	
	(14) Phenyl salicylate; Salol N.F	
	(15) Rosemary oil CNS	
	(16) Spearmint oil CNS	
	(17) Spike lavender oil, natural CNS	
	(18) Storax Ch.P	
	(19) Thyme oil Ch.P	
	(20) Thymol CNS or Ch.P	

	(21) Tolu balsam USP	
	(22) Turpentine oil Ch.P	
8	Sodium salicylate or Salicylic acid CNS or Ch.P	≧9 kilogram
	Fluid extract of quassia N.F	≧12.5 kiloliter
	Tert-Butyl alcohol	≧1.5 kiloliter
9	Sucrose octaacetate	≧1 kilogram
	Tert-Butyl alcohol	≧1.5 kiloliter
10	Other denaturants approved by the central competent authorities	

Annex 3: Examples of Denaturing Formula Frameworks

European Union (EU)⁸⁸ legislation distinguishes between two categories of denatured alcohol:

- **Completely denatured alcohol (CDA)** - Article 27 (1) (a): This is predominantly alcohol, which is for industrial use. In 2013, the EU introduced a common “Euro” formulation used by the majority of Member States for completely denatured alcohol (CDA):

Per HL of absolute alcohol

- 1L methyl ethyl ketone (a smelling agent)
- 1L isopropyl alcohol (a chemical analytical marker)
- 1gr denatonium benzoate (a tasting agent)

In a few Member States, there are varying combinations of the quantities of two of the three chemical agents, but all three chemical agents are present in all the Member States "Euro" formulations for CDA.

- **Partially denatured alcohol (PDA)** – applies to denaturing alcohol in products not intended for human consumption, but for which formulations for completely denatured alcohol are not suitable. Examples of such products include cosmetics, perfumes, hygiene products, biofuels, screen wash, anti-freeze, inks, cleaning materials etc. A finished product containing partially denatured, which is manufactured in one Member State, in line with EU provisions, may circulate freely in the Single Market, without the need for accompanying documents.

The United States⁸⁹ differentiates between two categories of denatured alcohol:

⁸⁸ Directorate-General for Taxation and Customs Union. (n.d.). Denatured Alcohol Not For Human Consumption. Brussels: European Commission. https://taxation-customs.ec.europa.eu/denatured-alcohol-not-human-consumption_en

⁸⁹ Alcohol and Tobacco Tax and Trade Bureau. (2021). Denatured Alcohol. Washington, DC : US Department of the Treasury. [https://www.ttb.gov/industrial/industrial-alcohol-denatured-alcohol#:~:text=Specially%20Denatured%20Alcohol%20\(SDA\)%20is,is%20not%20intended%20for%20consumption.](https://www.ttb.gov/industrial/industrial-alcohol-denatured-alcohol#:~:text=Specially%20Denatured%20Alcohol%20(SDA)%20is,is%20not%20intended%20for%20consumption.)

- **Completely Denatured Alcohol (CDA)** – is alcohol that has been so thoroughly denatured that the product is utterly unfit for beverage use, and the denaturants used are very nearly inseparable from the alcohol. The use of CDA is authorized without permit restrictions because of the reduced risk that the pure alcohol can be extracted and diverted to beverage use.
- **Specially Denatured Alcohol (SDA)** – is alcohol to which denaturing materials have been added. Manufacturers may use SDA in the manufacture of any products that are not intended for human consumption. Generally, SDA is used in cosmetic products, but its use extends to pharmaceuticals, chemical manufacturing, and products where SDA is the solvent or reactant.

The United Kingdom⁹⁰ has three approved categories of denatured alcohol⁹¹:

- **Completely denatured alcohol (CDA)** – is the most heavily denatured alcohol. The standard formulation for CDA produced in the UK is:

For every 100 parts by volume of alcohol:

- 3 parts isopropyl alcohol
- 3 parts of methyl ethyl ketone
- 1 gram of denatonium benzoate.

CDA can be used for heating, lighting, cleaning, and general domestic use. It can be sold in hardware stores and sometimes can also contain a dye.

- **Industrial denatured alcohol (IDA)** – is the grade of denatured alcohol designed for industrial use. It consists of 95 parts by volume of alcohol and 5 parts by volume of wood naphtha, or a substitute for wood naphtha.
- **Trade specific denatured alcohol (TSDA)** – is a type of denatured alcohol approved to meet specific trade needs which cannot contain regular denaturants which may damage skin (perfumes / deodorants) or the environment (screenwash). For example, the ink used to put the use by date on eggs, cannot contain strong chemicals so there is a specific lightly denatured formulation specifically for printing ink used on eggshells. It is important to note that even when TSDA is in its bulk form it retains its liability as a pure alcohol. It only becomes exempt once the final product has been produced, and it is packaged.

⁹⁰ HM Revenue & Customs. (2023). Production, distribution and use of denatured alcohol (Excise Notice 473). n.p.: HM Revenue & Customs. <https://www.gov.uk/government/publications/excise-notice-473-production-distribution-and-use-of-denatured-alcohol/excise-notice-473-production-distribution-and-use-of-denatured-alcohol>

⁹¹ HM Revenue & Customs. (2023). Production, distribution and use of denatured alcohol (Excise Notice 473). n.p.: HM Revenue & Customs. <https://www.gov.uk/government/publications/excise-notice-473-production-distribution-and-use-of-denatured-alcohol/excise-notice-473-production-distribution-and-use-of-denatured-alcohol>