REDUCING THE THREAT OF IMPROVISED EXPLOSIVE DEVICE ATTACKS BY RESTRICTING ACCESS TO EXPLOSIVE PRECURSOR CHEMICALS
Bombs are a weapon used by terrorists, violent extremists, and other malicious actors to cause death, injury, and fear throughout the world. An improvised explosive device (IED) is an unconventional, do-it-yourself type of bomb. A malicious actor can construct an IED with common materials, such as a switch and a battery power source, by following instructions easily found on the Internet.

The main charge in an IED can be and often is constructed from ready-made products (such as commercial explosives, military explosives, or pyrotechnics and propellants, including black and smokeless powders) or from a homemade explosive (HME) (see Figure 1).

**FIGURE 1.** The components, possible explosive materials, and role of precursor chemicals in an IED.

While both ready-made products and HMEs have been used in IEDs in recent bombings[1–3] and both are relevant to reducing the threat of IED attacks, this booklet specifically looks at reducing that threat by restricting access to precursor chemicals, namely, chemicals that can be used, through blending or chemical reaction, to produce HMEs. A 2017 study[4] outlines six recommendations to help keep precursor chemicals, all of which can be purchased legally for legitimate use, out of the hands of would-be bombers.
RECOMMENDATION 1

Combat Both Small and Large IEDs

The first recommendation is: “Federal, state, local, and private sector entities attempting to reduce the threat of IED attacks by restricting access to precursor chemicals should focus on both person-borne and vehicle-borne IEDs.”

Bomb makers construct IEDs in a range of sizes: vehicle-borne IEDs (VBIEDs, such as a truck bomb) can have a main charge of 40 to tens of thousands of pounds, depending on the carrying capacity of the vehicle, while person-borne IEDs (PBIEDs, such as a backpack bomb) usually have a main charge that ranges from 1 to 40 pounds, depending on what the person can carry. The truck bombs used against the World Trade Center in New York City in 1993 and the Murrah Federal Building in Oklahoma City in 1995 are examples of VBIEDs. The smaller bombs used in the Boston Marathon bombing in 2013 and the bomb incidents in New York and New Jersey in 2016 are examples of PBIEDs. While the Boston bomb used pyrotechnics as its main explosive, the others used HMEs made from precursor chemicals.

Before 2000, most high-profile bombing incidents involved large-scale devices, particularly VBIEDs. Thus, U.S. policy makers have tended to craft policy around concerns for VBIEDs. For example, the U.S. Department of Homeland Security (DHS) used a 1998 report that focused on the threat of VBIEDs to help establish a congressionally mandated program to regulate chemical facilities. In 2008, Congress directed DHS to regulate the sale and transfer of ammonium nitrate by ammonium nitrate facilities, which had been used in several VBIED attacks, including the Oklahoma City bombing. In 2011, DHS published a notice of proposed rulemaking for an “Ammonium Nitrate Security Program” and has since drafted a final rule, but the rulemaking process has not yet moved beyond that stage.

In recent years, however, a number of high-profile bombing incidents have involved PBIEDs. While a VBIED can cause more damage, a PBIED can be easier to construct and use. As both types of IED present a danger, policy makers should consider both in any attempt to reduce the threat of IED incidents by controlling access to precursor chemicals.
## SELECTED ATTACKS INVOLVING EXPLOSIVES
from 1970 to 2017 and the Mass of the Main Charge

<table>
<thead>
<tr>
<th>Year</th>
<th>Attack Description</th>
<th>Location</th>
<th>Mass of Main Charge</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>Sterling Hall Bombing</td>
<td>Madison, WI</td>
<td>2,000 lb</td>
</tr>
<tr>
<td>1983</td>
<td>Beirut Barracks Bombing</td>
<td>Beirut, Lebanon</td>
<td>20,000 lb*</td>
</tr>
<tr>
<td></td>
<td>U.S. Embassy Bombings</td>
<td>Beirut, Lebanon</td>
<td>2,000 lb</td>
</tr>
<tr>
<td>1992</td>
<td>St. Mary Axe Bombing</td>
<td>London, United Kingdom</td>
<td>2,000 lb</td>
</tr>
<tr>
<td>1993</td>
<td>World Trade Center Bombing</td>
<td>New York, NY</td>
<td>1,200 lb</td>
</tr>
<tr>
<td></td>
<td>Bishopsgate Bombing</td>
<td>London, United Kingdom</td>
<td>4,000 lb</td>
</tr>
<tr>
<td>1995</td>
<td>Oklahoma City Bombing</td>
<td>Oklahoma City, OK</td>
<td>5,000 lb</td>
</tr>
<tr>
<td>1996</td>
<td>Manchester Shopping Mall</td>
<td>Manchester, United Kingdom</td>
<td>3,000 lb</td>
</tr>
<tr>
<td></td>
<td>South Quay Bombing</td>
<td>London, United Kingdom</td>
<td>3,000 lb</td>
</tr>
<tr>
<td></td>
<td>Khobar Towers Bombing</td>
<td>Khobar, Saudi Arabia</td>
<td>20,000 lb*</td>
</tr>
<tr>
<td>1998</td>
<td>U.S. Embassy Bombings</td>
<td>Tanzania, Kenya</td>
<td>2,000 lb*</td>
</tr>
<tr>
<td>1999</td>
<td>Millennial Bomber Interdiction</td>
<td>Port Angeles, WA</td>
<td>500 lb</td>
</tr>
<tr>
<td>2000</td>
<td>USS Cole Bombing</td>
<td>Aden, Yemen</td>
<td>1,000 lb*</td>
</tr>
<tr>
<td>2001</td>
<td>Shoe Bomber (AA Flight 63)</td>
<td></td>
<td>1 lb*</td>
</tr>
<tr>
<td>2002</td>
<td>Bali Nightclub Bombing</td>
<td>Bali, Indonesia</td>
<td>2,000 lb</td>
</tr>
<tr>
<td>2003</td>
<td>Marriott Hotel Jakarta Bombing</td>
<td>Jakarta, Indonesia</td>
<td>100 lb</td>
</tr>
<tr>
<td></td>
<td>British Consulate Bombing</td>
<td>Istanbul, Turkey</td>
<td>2,000 lb</td>
</tr>
<tr>
<td></td>
<td>Casablanca Bombings</td>
<td>Casablanca, Morocco</td>
<td>20 lb</td>
</tr>
<tr>
<td>2004</td>
<td>Australian Embassy Attack</td>
<td></td>
<td>2,000 lb</td>
</tr>
<tr>
<td></td>
<td>U.S. Consulate Failed Attack</td>
<td>Karachi, Pakistan</td>
<td>2,000 lb</td>
</tr>
<tr>
<td>2004</td>
<td>Disrupted Jordanian Attack</td>
<td>Amman, Jordan</td>
<td>10,000 lb</td>
</tr>
<tr>
<td></td>
<td>U.S. Embassy Attack</td>
<td>Tashkent, Uzbekistan</td>
<td>20 lb</td>
</tr>
<tr>
<td></td>
<td>Madrid Train Bombings</td>
<td>Madrid, Spain</td>
<td>20 lb*</td>
</tr>
<tr>
<td>2005</td>
<td>7/7 Underground Bombing</td>
<td>London, United Kingdom</td>
<td>20 lb</td>
</tr>
<tr>
<td></td>
<td>7/21 Bombing</td>
<td>London, United Kingdom</td>
<td>20 lb</td>
</tr>
<tr>
<td>2006</td>
<td>Operation Overt</td>
<td>London, United Kingdom</td>
<td>1 lb</td>
</tr>
<tr>
<td></td>
<td>Disrupted Plot</td>
<td>Ontario, Canada</td>
<td>7,000 lb</td>
</tr>
<tr>
<td>2007</td>
<td>Disrupted Bomb</td>
<td>Ramstein, Germany</td>
<td>1,000 lb</td>
</tr>
<tr>
<td>2008</td>
<td>U.S. Embassy Attack</td>
<td>Sana’a, Yemen</td>
<td>100 lb*</td>
</tr>
<tr>
<td>2009</td>
<td>Underwear Bomber (NWA Flight 253)</td>
<td></td>
<td>1 lb*</td>
</tr>
<tr>
<td></td>
<td>Operation Highrise Interdiction</td>
<td>Denver, CO; New York, NY</td>
<td>10 lb</td>
</tr>
<tr>
<td>2010</td>
<td>Printer Bombs</td>
<td>United Kingdom; United Arab Emirates</td>
<td>1 lb*</td>
</tr>
<tr>
<td></td>
<td>Failed Times Square Plot</td>
<td>New York, NY</td>
<td>100 lb</td>
</tr>
<tr>
<td>2011</td>
<td>Khalid Ali-M Aldawsari Plot</td>
<td>Lubbock, TX</td>
<td>20 lb</td>
</tr>
<tr>
<td></td>
<td>Oslo Bombing</td>
<td>Oslo, Norway</td>
<td>2,000 lb</td>
</tr>
<tr>
<td>2012</td>
<td>Aurora Theater Shooting</td>
<td>Aurora, CO</td>
<td>20 lb*</td>
</tr>
<tr>
<td>2013</td>
<td>Boston Marathon Bombings</td>
<td>Boston, MA</td>
<td>20 lb*</td>
</tr>
<tr>
<td>2015</td>
<td>Paris Attacks</td>
<td>Paris, France</td>
<td>20 lb</td>
</tr>
<tr>
<td>2016</td>
<td>Brussels Attacks</td>
<td>Brussels, Belgium</td>
<td>40 lb</td>
</tr>
<tr>
<td></td>
<td>Ahmad Khan Rahami</td>
<td>New York; New Jersey</td>
<td>10 lb</td>
</tr>
</tbody>
</table>

*Incident did not involve homemade explosives.
BEYOND PRECURSOR CHEMICALS

Data on bombing incidents in the United States is limited. However, what data is available shows that in the United States, a substantial majority of incidents have used commercial explosives, pyrotechnics, and black powder, smokeless powder, and flash powder, perhaps due to their ease of legal acquisition.\[14-16\] This booklet focuses on precursor chemicals that can be blended or reacted to produce HMEs for IED attacks. However, any strategy that focuses only on access to precursor chemicals cannot eliminate the threat of IED attacks as long as these other explosive materials remain accessible to malicious actors.
The second recommendation is: “Federal, state, local, and private sector entities attempting to reduce the threats from person-borne and vehicle-borne IEDs should consider multi-chemical, rather than single-chemical, strategies.”

History shows that attempts to block malicious actors from accessing a weapon—or a component of a weapon—lead them to change tactics. For example, in the 1970s, numerous terrorist groups staged attacks using dynamite, including the Provisional Irish Republican Army (PIRA) in the United Kingdom, Fuerzas Armadas de Liberación Nacional in Puerto Rico, the Weather Underground and United Freedom Front in the United States. Both countries reacted by increasing restrictions on access to dynamite and malicious actors in each country responded in turn. In the United States, the bombers began using explosive materials like black and smokeless powders. Such materials were not accessible in the United Kingdom, but PIRA was able to obtain farm chemicals to replace the dynamite. PIRA began making HMEs with sodium chlorate from weed killer, but shifted to ammonium nitrate and later to calcium ammonium nitrate, under pressure from successive rounds of regulation.[17-18]

While it may be impossible to eliminate the threat of an IED attack, especially when black and smokeless powders and other ready-made products are available, a strategy for restricting access to precursor chemicals might help reduce it. However, the strategy is unlikely to help much if it addresses only one or a few chemicals.

Figure 2 shows many (but not all) of the precursor chemicals that can be used to make HMEs, each of which can be obtained legally and for legitimate use as industrial or agricultural inputs or as consumer goods.
### SYNTHESIS CHEMICALS

<table>
<thead>
<tr>
<th>Acetone</th>
<th>Aspirin</th>
<th>Erythitol</th>
<th>Ethylene Glycol</th>
<th>Glycerol</th>
<th>Hexamine</th>
<th>Hydrazine</th>
<th>Hydrogen Peroxide, Dilute</th>
<th>Mannitol</th>
<th>Methanol</th>
<th>MEK</th>
<th>Pentaerythritol</th>
<th>Phenol</th>
<th>Sodium Azide</th>
<th>Urea</th>
<th>UAN Solution</th>
</tr>
</thead>
</table>

### Strong Acids
- Sulfuric Acid
- Hydrochloric Acid
- Nitric Acid

### Weak Acids
- Citric Acid
- Acetic Acid
- Ascorbic Acid

### OXIDIZERS

<table>
<thead>
<tr>
<th>Hypochlorite Salts (Ca⁺²/ Na⁺)</th>
<th>Nitrate Salts (Na⁺/K⁺)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlorate Salts (Na⁺/K⁺)</td>
<td>Perchloric Acid</td>
</tr>
<tr>
<td>Hydrogen Peroxide, Concentrated (CHP)</td>
<td>Perchlorate Salts (Na⁺/NH₄⁺/K⁺)</td>
</tr>
<tr>
<td>Metal Peroxides (Ba²⁺/Na⁺)</td>
<td>Potassium Permanganate</td>
</tr>
</tbody>
</table>

### Nitrate Salts (Ca²⁺/ Na⁺/K⁺/NH₄⁺[AN]/Ca²⁺NH₄⁺[CAN])

### FUELS

#### Organic Materials
- Diesel
- Kerosene
- Mineral Oil
- Motor Oil
- Sawdust
- Vaseline

#### Inorganic Materials
- Aluminum (Al), Powder/Paste
- Antimony Trisulfide
- Charcoal
- Magnalium Powder
- Magnesium Powder
- Red Phosphorous
- Sulfur
- Titanium Powder
- Zinc Powder

#### Food Products
- Artificial Creamer
- Black Pepper
- Black Seed
- Cinnamon
- Cocoa
- Cumin
- Flour
- Honey
- Icing Sugar
- Powdered Drink Mix

### Energetic Organic Compounds
- Nitrobenzene
- Nitromethane (NM)

**NOTE:** Ca⁺²: calcium; Na⁺: sodium; K⁺: potassium; Ba²⁺: barium; NH₄⁺: ammonium; AN: ammonium nitrate; CAN: calcium ammonium nitrate; MEK: methyl ethyl ketone; UAN: urea ammonium nitrate.
It would be impossible to restrict access to all precursor chemicals without disrupting people’s lives and commerce. For example, many of the chemicals shown in the figure are common household items, such as foods (e.g., flour and cocoa) or ordinary fuel sources. For this reason, the 2017 study[4] identified a smaller number of key chemicals and then ranked them by priority for policy makers.

As a first step, the study committee removed the ubiquitous chemicals—such as foods and common fuels—and those used in very small amounts. With that step, the number of chemicals dropped to 28.

A second step used three criteria to prioritize the 28 remaining chemicals. Those that pose the greatest threat (1) can be used to make HMEs for PBIEDs and VBIEDs, satisfying both purposes, (2) have been used in bombings in the past, and (3) are not dependent on one other chemical, but can be used with a variety of other chemicals to make an HME. While other precursor chemicals still pose a threat, these top priority chemicals (shown in the sidebar) are ones that merit particular concern, with the caveat that any strategy should be flexible enough to allow changes in priorities as circumstances change. At any point in the future, circumstances can change, causing other chemicals from the list of 28 to move up to a top priority precursor chemical. Continuous reevaluation of the precursors is encouraged, as some of the rankings may change over time with an evolving threat environment.

| TOP PRIORITY PRECURSOR CHEMICALS |
|-----------------|-----------------|
| Aluminum (powder, paste, flake) | Nitromethane |
| Ammonium nitrate | Potassium chlorate |
| Calcium ammonium nitrate | Potassium perchlorate |
| Hydrogen peroxide | Sodium chlorate |
| Nitric acid | Urea ammonium nitrate solution* |

* The decision to include urea ammonium nitrate (UAN) solution in the top priority precursor chemicals list represents the only departure from a strict application of the committee’s ranking principles. The ease of producing various explosives from nitrating urea solutions, as seen elsewhere, supports the notion of UAN as a future threat and justifies its inclusion as a top priority.
RECOMMENDATION 3

Focus on Retail-Level Access

The third recommendation is: “Federal, state, local, and private-sector entities attempting to reduce the threats from person-borne and vehicle-borne IEDs should focus on retail-level transactions of precursor chemicals, especially e-commerce.”

The 2017 study[4] examined the U.S. supply chains of the top priority precursor chemicals, from their origin in the country (as an import or manufactured product) to their consumption in industry or retail purchase. As mentioned above, all of these priority chemicals play a part in legitimate commerce, with users located throughout the economy. Figure 3 shows an overall, stylized supply chain: Chemicals enter the supply chain at blue nodes, are stored or transported at gray nodes, and are transformed into something else or consumed at green nodes. Purple indicates the possibility of e-commerce, directed toward consumers.

Many programs, both mandatory and voluntary, are in place along this supply chain, especially near the start, but various federal and other agencies administer them differently and for different purposes, according to their respective organizational goals. At the federal level, for example, the Department of Transportation regulates hazardous materials during transport for safety reasons, while the Environmental Protection Agency focuses on public health and environmental protection and DHS targets security. The Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF) directly regulates chemicals that are defined statutorily as explosive materials, but only regulates one of the identified 28 precursor chemicals (ammonium perchlorate).[19,20] Still, ATF’s regulatory oversight does apply to nodes where the precursor chemicals are manufactured into explosive materials.

Citing this configuration of programs, agencies, and goals as a contributing factor, the 2017 report calls out inconsistencies and possible gaps in coverage relative to concerns about precursor chemicals and IED attacks, both large and small. Among the latter, DHS identifies and regulates high-risk chemical facilities, subject to thresholds for monitoring, such as 400 lb of nitric acid or 2,000 lb of ammonium nitrate, that may not be ideal for preventing access to PBIED-relevant quantities of precursor chemicals.[7,21-25] Of 60,000 initial assessments submitted for review by 38,000 unique facilities,[24] only 2,570 are currently covered as high risk.[25] The remaining facilities do not have to implement security plans because they store chemicals below the specified thresholds. The below-threshold amounts might be more than large enough to produce a PBIED, even if they are not large enough to construct a VBIED.

In addition, the report suggests opportunities for better coordination among federal, state, and local programs and with voluntary programs.

Examples of voluntary programs are discussed below under recommendation 6.

- **Import**: Node where a precursor or formulation containing it enters the supply chain.
- **Manufacture**: Node where a precursor ceases to be that chemical.
- **Export**: Node where a precursor or formulation containing it is held temporarily.
- **Rearrange/Repackage**: Area of supply chain where e-commerce is relevant to consumers.
- **Transportation**: Distribution nexus, where precursors can move between all forms of transportation and included nodes.
- **Temporary Storage**: Includes pipeline, railroad, barge or vessel, trucking, air freight.
- **Distribution/Wholesaler**: May include distribution and intake locations.
- **Retailer**: Point of Sale
- **Agricultural Retailer**: Point of Sale
- **Amature Production**: May include distribution and intake locations.
- **Industry**: Includes pipeline, railroad, barge or vessel, trucking, air freight.
- **Agriculture**: Includes pipeline, railroad, barge or vessel, trucking, air freight.
- **Consumer**: Includes pipeline, railroad, barge or vessel, trucking, air freight.

Key Recommendations | 9
FIGURE 4. The generalized supply chain overlaid with relevant controls and other measures or activities (black circles).

- **Export**: \( E O G T \Omega \Pi \)
- **Import**: \( E O G T \Omega \)
- **Manufacture**: \( A C E O T \Omega \Pi \)
- **Remanufacture/Repackage**: \( C E O T \Omega \)
- **Agricultural Retailer**: \( C E O S T \Omega \Pi \)
- **Retailer**: \( T \Omega \Pi \)
- **Amateur Production**: \( \)
Figure 4 shows the same supply chain presented in Figure 3 superimposed with the various agencies, partnerships, and programs that play a part in oversight, either mandatory or voluntary, at each node. (Remember that institutional presence at a node does not ensure comprehensive oversight for all chemicals.) Multiple organizations monitor the chemicals early in the supply chain (blue nodes), as the chemicals are transported and stored (gray nodes), and when the chemicals are exported. Fewer or no organizations monitor the chemicals as they are sold to end users (green nodes) outside of industry and agriculture.[4]

Nevertheless, industry tracks movement of precursor chemicals, especially in bulk quantities, through much of the supply chain. Documentation includes purchase orders, shipping information, and proof of delivery. This documentation could draw attention to a product that is misappropriated for use in HMEs, for example, if a terrorist steals chemicals during transport. But the final step in the supply chain—the sale of the chemicals to the end user—often lacks equivalent visibility, particularly if purchasers use cash. In addition, because anyone can legally purchase those chemicals, their purchase might not send up any red flags that a bomb maker is acquiring chemical ingredients.[26]

Thus, the report concluded that the retail level should be an area of focus. At that level, there is substantially less oversight and visibility than elsewhere in the supply chain and the risk of misappropriation appears to be the greatest, both because of the high volume of small transactions that typically fall below regulatory thresholds and because many more locations are involved (e.g., thousands of sales outlets for some products).

E-commerce adds additional complexity to the situation. A purchaser can order chemicals without showing his or her face in a store, and purchases can cross state lines, bypassing local-level restrictions on access. Although online purchases can be tracked, there is no inherent means to verify a purchaser’s true identity. One person could purchase multiple quantities of chemicals using various identities, or from various sellers, to avoid notice.

Still, evidence from other venues and programs suggests the potential for risk reduction. For example, in the EU, discussed more under recommendation 5, preliminary evidence from retail-level controls indicates a decrease in the amount of chemicals for sale and an increase in reports of suspicious retail transactions. Some options to better monitor and control retail-level sales are also discussed under recommendation 5.
The fourth recommendation is: “Federal, state, local, and private-sector entities should explore strategies for harmonizing oversight of the sale and use of commercially available kits that contain precursor chemicals that are specifically designed to be combined to produce homemade explosives.”

These days, it is easy for bomb makers and potential bomb makers to find the chemicals they need in person or online, along with instructions for how to use them to make an explosive. An extreme example of this is the exploding target kit.

An exploding target kit contains two precursor chemicals (usually ammonium nitrate and aluminum powder) that are mixed to make an explosive. The kit’s intended use is as an aid in target practice; when struck with a bullet, the exploding target explodes, showing the shooter that he or she hit the mark. As evidenced from online videos and news reports, however, the kits can be and have been misused with malicious intent. Ahmad Khan Rahami used a chemical from an exploding target kit in the New York and New Jersey attacks in 2016. These kits are widely available through Internet retailers and in physical stores.

The kits are especially problematic for a few reasons:

- They are easy to use and include mixing instructions that obviate the need for any technical know-how
- They contain precursor chemicals in the optimal physical form to make an explosive
- They contain precursor chemicals in a weight ratio for optimized sensitivity to initiation
- They produce a mixture within seconds that either explodes violently or detonates with minimal energy input

Exploding target kits generally slip through the cracks of oversight because they are not considered explosives until they are mixed, and their components fall below regulatory thresholds. ATF does not regulate the distribution and sale of exploding target kits because the individual components, when unmixed, do not meet the definition of explosive materials that establishes ATF’s regulatory jurisdiction. Moreover, consumers do not require an ATF manufacturing license to mix the components because mixing falls under personal use. DHS monitors relevant precursor chemicals, but only when present above certain thresholds (2,000 lb for ammonium nitrate and 100 lb for aluminum powder). Even if a retail store had enough kits to require monitoring, DHS would only monitor the store’s security and not the transactions.
Currently, the only federal oversight of the kits is from the U.S. Forest Service, which bans their use on certain federal lands to prevent forest fires.\[^{29}\]

Some states attempt to control the kits (see Figure 5). For example, five states regulate purchases or possession via licensing or permitting,\[^{30-36}\] while ten states regulate mixing under statutes that require a license to manufacture and possess explosives.\[^{37-46}\] States have varying definitions of “explosives” (with some states including kit components in the definition) and “lawful purpose” in relation to explosives. In addition, the FBI provides an advisory for retailers of exploding target kits.\[^{47}\]

**FIGURE 5.** State Controls on Exploding Target Kits and Their Use

- The state requires a license or permit to purchase or possess a kit
- The state requires a license or permit to mix the components of a kit
- The state requires a license or permit to use an exploding target
- There is ambiguity in the statute regarding lawful use
- The state has only proposed laws
- The state has a 5 lb licensing threshold
Even with some state-level controls in place, determined bomb makers can easily cross state lines to acquire kits. Options for harmonizing oversight of the sale and use of exploding target kits could include the following:

- Congress could expand DHS’s statutory authority to cover exploding target kits;
- Congress could expand ATF’s statutory definition of explosives to include exploding target kits;
- State or local governments could establish new controls for the purchase or use of the kits, or could redefine terms such as “explosives” and “lawful use” to cover the kits under current regulations; and
- Manufacturers, distributors, and retailers could develop voluntary measures to reduce threats of misappropriation, for example, by securing materials, training employees to recognize suspicious behavior, and reporting suspicious behavior or transactions.
RECOMMENDATION 5

Analyze Specific Provisions for Strategies

The fifth recommendation is: “U.S. DHS should engage in a more comprehensive, detailed, and rigorous analysis of specific provisions for proposed mandatory and voluntary policy mechanisms to restrict access to precursor chemicals by malicious actors.”

Precursor chemicals can be used to make bombs, but they also have many legitimate uses. They are used in industry and agriculture and by the public for both commercial and noncommercial purposes (e.g., cosmecitians use peroxide-based bleaching products and hobbyists use nitromethane as a fuel in radio-controlled vehicles, respectively). Any attempt to stop precursor chemicals from being used to make IEDs by restricting access at the retail level must consider the effects on commerce and legitimate users.

The 2017 report[4] included an assessment of different strategies to reduce the threat of using precursor chemicals in IEDs by controlling access at the retail level. Any policy that attempts to do this would have three goals:

1. Restrict access to precursor chemicals by malicious actors
2. Gather and share information that might aid in responding to or preventing a terrorist incident
3. Minimize the burden on legitimate commerce and use

In general terms, the assessment looked at four possible types of control strategies that could include a mix of mandatory and voluntary policy mechanisms. Because of the third goal, minimizing the burden on commerce, commercial users were exempted from new mandatory restrictions if they were able to provide evidence of commercial status. Noncommercial users, however, could encounter one of the following:

1. A ban on purchasing
2. A requirement for a license to purchase
3. A requirement to sign a registry and show ID to purchase
4. Existing (but potentially augmented) requirements to purchase

In each of the first three cases, the purchaser, if non-commercial, would face a new mandatory restriction, that is, a ban, a licensing requirement, or a registry and signature requirement. In the fourth case, the purchaser would face any existing controls, including state or local, but would not face any new ones. All four approaches could be supplemented with outreach, training, reporting, documentation, auditing, and inspections, resulting in the complete strategy package. For example, retailers might train staff to request and verify evidence of commercial status or a license, or to properly register people buying certain chemicals. Retailers might report suspicious behavior by purchasers or the theft or other loss of the chemicals, or might document sales. These additional
policy mechanisms could be voluntary or mandatory. (Use of voluntary measures is discussed further under recommendation 6.)

The assessment, which was just qualitative, looked at the benefits, costs, and uncertainties of each of the first three strategy packages and ranked them accordingly. The assessment did not indicate a clear “winner” among those strategies, but it did highlight various tradeoffs. For example, a ban would be more restrictive than licensing or a registry; would possibly be cheaper to implement, administer, and enforce; and could result in faster transaction times, but it might also result in the most lost sales and use and entail the greatest additional social cost in terms of lost personal freedom. Although a ban might be the most difficult option for terrorists to circumvent and could make people feel safest, it might also be most likely to disrupt commerce or to “displace” terrorists, prompting them to switch to different tactics.

The assessment also considered the benefits, costs, and uncertainties of the supplemental measures and activities, some of which could result in gains in security and information gathering but would still entail costs and uncertainties. For example, training and reporting on suspicious behavior, fraud, theft, and loss could create better awareness of chemicals and concerns, and could reduce purchases by malicious actors and lead to better tracking and visibility at the retail level. However, these measures would cost money to administer and implement.

Nationwide control strategies for precursor chemicals are already in use in some countries. The EU, which has had to grapple with the diverse circumstances of 28 member states much as the United States must consider the circumstances of its own constituents, passed a regulation in 2013 on the sale and use of certain precursor chemicals that defaults to a ban on sales to noncommercial users, referred to as “members of the general public,” but allows member states to instead use licensing or a registry. Figure 6 shows how various EU member states have chosen to restrict access. Since the regulation passed, the EU reports that the amount of precursor chemicals for sale has decreased and that authorities’ capacity to investigate suspicious incidents involving the chemicals has increased, but with some cost to commerce and legitimate users. However, the EU has also noted challenges: for example, authorities face difficulties reaching retailers and enforcing restrictions on Internet sales, imports, and intra-EU product flows; differences among member states’ programs can obstruct legitimate commerce; and retailers have had difficulty identifying which products fall under the regulation and which purchasers are legitimate commercial users. The United States could face similar challenges; already, differing state laws concerning ammonium nitrate might cause confusion that inhibits commerce and undermines state’s efforts to mitigate risk.

The results of the assessment of the strategy packages, noted above, are illustrative, but for a policy change to occur, policy makers need more detail. Benefits and costs of specific provisions should be studied comprehensively, preferably with numbers attached. The different effects of voluntary measures and mandatory measures should be considered, as well as the effect of applying the controls to commercial purchases or to certain quantities of chemicals. U.S. policy
makers should consider the results of existing U.S. programs that restrict access to precursor chemicals, including those intended to curb illicit drug production, and of existing programs worldwide. This more rigorous analysis would help policy makers objectively consider the tradeoffs and build consensus about the benefits and costs of different options. Therefore, DHS should conduct a more detailed and comprehensive analysis of possible strategies for restricting access to precursor chemicals to reduce the threat of IED attacks.

Supplementary to this recommendation, the 2017 report urged policy makers to identify and overcome impediments to further analysis, including time constraints and lack of funds, expertise, or suitable analytical tools and methods.
DYNAMIC POLICIES

Policy regarding precursor chemicals should not be static. For one, use of some chemicals might wane and others take precedence as situations and technology change; no list of priority precursors can be immutable. For another, experience—good or bad—can inform policy making and implementation. If a control strategy can be reduced, expanded, or reoriented to meet changing needs or improve functionality, it can better serve policy, but the strategy can only do so if it is alterable.

Evaluation is needed to help policy makers leverage experience. Although it can be difficult to separate out the effects of a control strategy, it is still possible to examine participation rates, inspection results, data on terrorist episodes, and evidence from elsewhere. If, as suggested above, the policy community can identify and overcome impediments to analyzing the benefits and costs of strategy proposals, it would likely help in this effort.
The sixth and final recommendation is: “The federal government should provide additional support for voluntary measures, activities, and programs that can contribute to restricting access by malicious actors to precursor chemicals used to manufacture IEDs.”

Voluntary measures, activities, and programs can help to restrict potential bomb makers’ access to precursor chemicals. They can—and in some instances already do—include the supplemental efforts listed in recommendation 5:

- Outreach and training seek to raise awareness and to educate retailers about precursor chemicals, including their oversight and safety, to help them to recognize suspicious behavior, and to encourage them to adopt best practices
- Reporting on suspicious behavior, fraud, theft, and loss aims to prevent terrorist incidents or facilitate better responses to them, for example, by providing details on the circumstances of suspicious purchases of precursor chemicals
- Documentation can preserve information that might be useful to investigators seeking to prevent or follow up on a bombing incident
- Audits and inspections can be used to evaluate retailers’ practices as tools for education or enforcement; random audits catch them off guard, while planned inspections allow them to prepare
- Mystery shopping, which is used as an educational tool in the EU, is a type of audit in which an “actor” attempts to purchase a precursor chemical and then provides feedback to the retailer or responsible authorities on the transaction, if it was done properly, and what, if anything, could be done better in the future

These types of efforts could be made mandatory or voluntary, as noted under recommendation 5, but businesses might choose to participate in voluntary programs and act voluntarily for many reasons: for example, they do not want to enable terrorism or harm to others; they do not want to be seen as a business that enables terrorism or harm to others and risk losing sales from a bad reputation; or they do not want to risk being financially liable for a terrorist incident. In addition, trade associations can take steps, as described below, to encourage their members to participate and act, for example, through education and outreach, by highlighting members’ performance, and by conditioning membership on compliance.

There are currently many voluntary programs in use in the United States.
Some voluntary programs result from public-private partnerships. For example, the Federal Aviation Administration created the Known Shipper Program to allow air carriers to follow different procedures for shippers that have previously been vetted.[52,53] Customs and Border Patrol works with shippers through the Customs-Trade Partnership Against Terrorism to develop security plans in exchange for reduced inspections and faster processing.[54,55]

Other voluntary programs are sponsored by trade associations. For example, the Institute of Makers of Explosives provides members with best practices training materials and tools, and requires members to comply with safety guidelines.[56] The American Chemistry Council requires members to participate in its Responsible Care program, which promotes security and safety[57, 58] and makes public the performance of companies to motivate them to comply. ResponsibleAg Inc. is a nonprofit that certifies agribusinesses that comply with federal regulations regarding the safe handling and storage of fertilizer products, and assists them in doing so.[59-61] While these programs might be required of association members, they are considered voluntary because membership in the association is voluntary.

Both industry and the government engage in voluntary outreach activities. For example, ATF runs programs like Be Aware for America to educate the fertilizer industry on illegitimate use of precursor chemicals, encourage voluntary reporting of suspicious activity involving the precursors, and increase awareness of security vulnerabilities.[62] The FBI performs similar outreach targeted at retailers.[63] In addition, both government[64,65] and private groups[66] have written and made available literature on best security practices, which industry can choose to implement.

While a mandatory program, measure, or activity might have more force than a voluntary one, due to the threat of fines or imprisonment, voluntary approaches can and have gained acceptance, with some effect. For example, within a few years, 2,282 facilities participated in the ResponsibleAg program, with 452 reaching full compliance,[60] and Responsible Care has reduced health and safety incidents at member companies by 53–78 percent (depending on the measure).[57, 58]

Voluntary programs, such as those designed to educate retailers on how to identify suspicious activity, might be most effective if designed with input from businesses’ leadership so that the programs can become part of the prevailing corporate culture.
Precursor chemicals have been used to make HMEs for IEDs used in terrorist attacks. Such an attack in the United States might someday prompt policy makers to make a rapid and narrow decision about controlling the chemicals, as has sometimes happened in the past. However, a decision made rapidly and under the duress of a recent attack will probably not lead to the best long-term strategy for reducing further attacks. Instead, engaging in deliberative thinking before an attack occurs can help to avoid the pitfalls of intuitive thinking and a bias toward action during and after crises.\cite{67,68}

Congress has an essential role in developing and implementing appropriate risk-reducing control strategies. They are poised to define the responsibilities of federal agencies, gather information via fact-finding hearings, and adequately fund collaborative public-private work, among other things. In particular, Congress can help to ensure that crisis-driven interests do not unduly influence new laws or regulations. The six recommendations in this booklet are first steps that policy makers can take to reduce the threat posed by the availability of precursor chemicals and ensure the safety of our nation.
FURTHER RESEARCH NEEDED

In addition to the six recommendations given in this booklet, at least four areas merit additional research.

1. **Data collection from incidents involving explosives**
   Data from incidents is needed to track the changing use of precursor chemicals in IEDs and to provide an analytical perspective. The U.S. Bomb Data Center, which collects and stores relevant domestic data, and other federal agencies should focus on collecting detailed and verified data on incidents involving explosives. Focus areas include the following: improving data collection on the chemical composition of the explosives used in IEDs and the precursor chemicals recovered during incidents and investigations; verifying data when final laboratory results become available; aggregating and presenting data; improving data entry compliance for robustness and timeliness; and conveying policy makers’ information requirements to the U.S. Bomb Data Center.

2. **Substitute chemicals**
   While many products require the particular precursor chemicals listed on page 7 as ingredients, other products might be able to use less risky alternatives. In some instances, the changes might be straightforward, for example, replacing the ammonium nitrate in cold packs with a different salt, but in other instances the changes, including identification, might require substantial effort. Given the costs of research, development, and implementation in those cases, clear incentives would be needed from the market or elsewhere to initiate the process.

3. **Standardized thresholds**
   Current regulations use a variety of mass and concentration thresholds to control chemicals. The different thresholds may create unnecessary confusion for legitimate commerce and still not prevent malicious actors from purchasing the precursor chemical at the quantity or quality needed to manufacture HMEs. For example, 35 percent concentration is DHS’s threshold for monitoring hydrogen peroxide, which exempts most products from oversight, but lower concentrations can be used to make the explosive triacetone triperoxide.[69] A systematic study to identify the thresholds based on sound scientific principles would contribute toward the goal of preventing the use of precursor chemicals in HMEs.

4. **Behavioral responses**
   The 2017 report suggests further research into the behavioral responses of (a) malicious actors, businesses, and end users to policy, and (b) the public and policy makers to the threat of a terrorist act or an actual terrorist act, both of which can affect the benefits and costs of policy efforts. Research could delve into questions in each dimension. For example, how much knowledge is needed for a terrorist to circumvent a control, or what perception of difficulty will cause a shift in tactics? How much inconvenience will businesses or consumers tolerate? Are there ways to ingrain and encourage deliberative thinking in policy making processes, especially in the midst of crises, without forestalling decision making?
REFERENCES


24 | Reducing the Threat of Improvised Explosive Device Attacks by Restricting Access to Explosive Precursor Chemicals

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DISCLAIMER

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