EIU METHODOLOGY

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EXECUTIVE SUMMARY

To gain a better understanding of current global nuclear security conditions, the Nuclear Threat Initiative (NTI) commissioned the Economist Intelligence Unit (EIU) to construct the latest edition of the NTI Nuclear Security Index (2018 NTI Index). The 2018 NTI Index provides a country-level assessment of nuclear security conditions in 176 countries. It follows the release of three earlier iterations of the NTI Index—in January 2012, January 2014, and January 2016, respectively.

The 2018 NTI Index divides countries into three ranking groups. The first (the theft ranking for countries with materials) assesses the 22 countries that have one kilogram or more of weapons-usable nuclear materials. The second (the theft ranking for countries without materials) assesses nuclear materials security conditions in 154 countries that have less than one kilogram of weapons-usable nuclear materials, or no such materials, but that could serve as safe havens, staging grounds, or transit points for illicit nuclear activities. Those first two models provide a comparison of each country's nuclear materials security conditions since 2012. Finally, a third (the sabotage ranking) assesses nuclear security conditions in 44 countries and Taiwan in which an act of sabotage against a nuclear facility could result in a significant radiological release with serious off-site health consequences. The sabotage ranking was first incorporated into the 2016 NTI Index to address the threat of sabotage and the serious consequences that could result from a large radiological release.

Nuclear security is particularly difficult to observe, both because of the legacy of secrecy associated with the subject and because of the absence of quantitative indicators of nuclear security performance. To address the need for an objective, country-level assessment of nuclear security, the EIU developed a multidimensional analytical framework, commonly known as a benchmarking index. A multidimensional framework is a useful way of measuring performance that cannot be directly observed, such as a country's economic competitiveness or, in this case, a country's nuclear security conditions. Indices, in such cases, have been shown to be effective in several ways: (a) they can aggregate a wide range of related data and evaluate it in a consistent manner; (b) they can track outcomes over time; and (c) they can spur countries to improve performance, especially relative to other countries in the index. In this way, indices can be a useful tool for public policy reforms. The goal of the NTI Index, then, is not only to prompt improvements in national nuclear security policies and programs, but also to encourage international debate on the factors that affect the likelihood of a country losing control of its weapons-usable nuclear materials or its being subject to an act of sabotage.

The 2018 NTI Index is again the result of collaboration between NTI and the EIU. The 2012 NTI Index theft ranking for countries with materials assessed 32 countries with weapons-usable nuclear materials across 18 indicators, the 2014 NTI Index theft ranking for countries with materials assessed 25 countries across 19 indicators, and the 2016 NTI Index theft ranking for countries with materials assessed 24 countries across 20 indicators. The 2018 NTI Index theft ranking for countries with materials assesses 22 countries—with the steady decline in the number of countries within the theft ranking for countries with materials reflecting the removal of all or most of such materials from the territories of 10 countries since 2012[1]—across 20 indicators.[2] The NTI Index sabotage ranking, added in 2016, assesses 44 countries and Taiwan across 16 indicators.

The EIU researched every metric captured in the NTI Index and paid particularly close attention to any changes to regulations or licensing conditions in a country. As a result of repeated changes to the NTI Index framework since 2012, direct year-on-year comparisons between the rankings in the 2018 NTI Index, the 2016 NTI Index, the 2014 NTI Index, and the 2012 NTI Index would not have been possible. To allow for such comparisons, the EIU rescored countries in the 2012, 2014, and 2016 NTI Indices using the updated 2018 framework and the data that would

[1] Austria, the Czech Republic, Hungary, Mexico, Sweden, Ukraine, and Vietnam removed all or most of their weapons-usable nuclear materials between the release of the 2012 NTI Index and the release of the 2014 NTI Index. Uzbekistan eliminated its stock of weapons-usable nuclear material between the release of the 2014 NTI Index and the release of the 2016 NTI Index. Argentina and Poland removed all or most of their materials following the release of the 2016 NTI Index.

[2] The number of countries included in the sabotage ranking did not change between 2016 and 2018, although is likely to grow as more countries seek to construct new nuclear power plants. The United Arab Emirates, for example, is expected to start its first nuclear reactor in 2019.

have been available in 2011, 2013, and 2015, respectively, when research for the 2012, 2014, and 2016 NTI Indices was conducted.

In addition, the results from the 2012, 2014, and 2016 NTI Indices were thoroughly reviewed and researched again to ensure accuracy. In a limited number of cases, research or responses to the data review and confirmation process indicated that new information had become available, a relevant law or regulation had not been captured, or researchers had disagreed on a score. In those instances, the EIU revised the 2012, 2014, and 2016 scores to reflect the most accurate data. Rescoring the 2012, 2014, and 2016 data was necessary so the 2018 NTI Index could capture accurate year-on-year comparisons. Most research for the 2018 NTI Index was conducted between October 2017 and April 2018, although data were updated as new information became available until June 15, 2018.

NTI and the EIU once again drew on the expertise of highly respected nuclear security experts (the International Panel of Experts) from nuclear-weapon and non-nuclear weapon states, from countries with and without materials, and from developed and developing nations, to provide input on options to strengthen the 2018 NTI Index. This input included discussions around the development of a new cybersecurity subindicator, as well as how to continue to promote progress on nuclear security in the absence of the Nuclear Security Summit process.

The categories in the theft ranking for countries with material, as well as in the sabotage ranking, are (a) Quantities and Sites, which captures the quantity of nuclear materials in a particular country plus the number of sites, and the frequency with which they are transported (all are related to the risk that materials could be stolen); (b) Security and Control Measures, which encompasses the core activities related to the physical protection and accounting of weapons-usable nuclear materials, as well as personnel and security infrastructure and cybersecurity; (c) Global Norms, which includes actions that contribute to an international consensus on improved security; (d) Domestic Commitments and Capacity, which indicates how well a country has implemented its international commitments and the country's capacity to do so; and (e) Risk Environment,[3] which examines issues that can undermine nuclear materials security at the national level, such as political instability, absence of effective governance, corruption, or presence of groups interested in illicitly acquiring materials.

The research for both the theft ranking for countries with materials and the sabotage ranking primarily considered regulatory requirements for security. Taking a so-called bottom-up approach and reviewing security at the facility or site level within each country was impossible, not least because of national security concerns. Researching domestic regulations also posed a challenge: some countries do not make public the majority of their nuclear security regulations, and two countries in particular, Israel and North Korea, do not make any regulations public. Owing to those research challenges, the EIU used a variety of techniques to score certain countries (see Research behind Selected Indicators).

To limit the degree of subjectivity in these indicators, the EIU created subindicators that were, whenever possible, framed as a binary choice (yes or no; or 1 or 0). For example, the EIU asked if a country has a national authority for implementing the Convention on the Physical Protection of Nuclear Materials (CPPNM). If a country does, it is awarded one point; if it does not, it scores a zero. A binary approach limits the risk of subjectivity and increases the likelihood that the same scores would be obtained by another set of researchers, a key measure of objectivity and analytical rigor. If a binary approach was not appropriate, the research team provided specific scoring options that were based on publicly available information.

Despite the care taken in designing such measures, no index of this kind can ever be perfect. Some countries are particularly non-transparent in matters of nuclear security. In those cases, the EIU scored indicators using expert judgment or relied on proxy measures, such as the sophistication of a country's military operations (in cases in which the EIU was confident that weapons-usable nuclear materials and nuclear facilities vulnerable to sabotage were protected by the armed forces).

The indicators in the 2018 NTI Index are embedded in a model (available as an Excel workbook at www.ntiindex.org) that offers a wide range of analytical tools, thereby allowing a deeper investigation of measures of nuclear

[3] This category was named Societal Factors in the 2012 NTI Index.

security globally. For example, users can filter countries by region or by membership in international organizations or multilateral initiatives. A user can directly compare any two countries and can examine correlations between indicators. Individual country profiles are also included in the 2018 NTI Index model, thus permitting a deeper dive into the nuclear security conditions in a given country.

The weights assigned to each indicator can be changed to reflect different assumptions about the importance of categories and indicators. A user can also change individual subindicator scores to see how a country's overall scores would have been different if it had, for example, ratified a treaty or taken some other action captured in the 2018 NTI Index. Finally, the model allows the final scores to be benchmarked against external factors that may potentially influence nuclear security. For example, the results of the theft ranking for countries with materials correlate well with regulatory quality (as measured by the World Bank's Worldwide Governance Indicators) and with those that are most at peace (as measured by the 2017 Global Peace Index).

SCORING CRITERIA AND CATEGORIES

The 2018 NTI Index includes three separate rankings. The first model assesses the nuclear materials security conditions in 22 countries that have one kilogram or more of weapons-usable nuclear materials (theft ranking for countries with materials). This model has 61 subindicators used to construct 20 indicators across five categories. The scope of the theft ranking for countries with materials includes only highly enriched uranium (HEU), including spent fuel; separated plutonium; and plutonium in unirradiated mixed oxide fuel (MOX).

A second, separate model in the 2018 NTI Index assesses the nuclear materials security conditions in 154 countries that have less than one kilogram of or no weapons-usable nuclear materials, but that could serve as safe havens, staging grounds, or transit routes (theft ranking for countries without materials).[4] The number of countries in the theft ranking for countries without materials was determined by the scope of EIU's Risk Briefing service.[5] Countries without materials are evaluated across a smaller subset of 3 categories and 9 indicators.

Finally, the third ranking (or model) covers sabotage. The sabotage ranking assesses nuclear security conditions in 44 countries and Taiwan with nuclear facilities, the sabotage of which could lead to a significant radiological release with serious off-site health consequences.[6] The sabotage ranking scores 16 indicators and 52 subindicators across five categories.

Note that the NTI Nuclear Security Index does not address proliferation risks, disarmament, or nuclear safety.

Theft Ranking for Countries with Materials

The overall score (0–100) for each country in the theft ranking for countries with materials is a weighted sum of the five categories. Each category is scored on a scale of 0–100, in which 100 represents the most favorable nuclear materials security conditions and 0 represents the least favorable conditions. A score of 100 in the theft ranking does not indicate that a country has perfect nuclear materials security conditions; likewise, a score of 0 does not mean that a country has no security. Instead, the scores of 100 and 0 represent the highest or lowest possible score, respectively, as measured by the NTI Index criteria. Each category is normalized on the basis of the sums of its underlying indicators and subindicators, and a weight is then applied. The weights used in the ranking are based on input from the International Panel of Experts and reflect the relative importance and relevance of each indicator and category. The weights in the model, however, are dynamic and can be changed by users.

[4] NTI recognizes that some countries may have gram quantities of weapons-usable nuclear materials in multiple locations that, added together, may bring their totals to more than one kilogram. For the NTI Index, however, because of its need to rely on publicly available information, those countries are grouped with countries that have no weapons-usable nuclear materials.

[5] The EIU's Risk Briefing service provides forecasts, alerts, background studies, and data covering a wide range of risk factors across 180 countries. The service is updated regularly in response to events that affect the assessment of operating risk in a particular country.

[6] The nuclear facilities are (a) nuclear power reactors that are in operation or that have been shut down within the past five years, (b) research reactors with a capacity of 2MW or greater, (c) reprocessing facilities, and (d) spent fuel pools—if the fuel has been discharged in the past five years and is not associated with an operating reactor.

The five categories of the theft ranking for countries with materials are as follows:

1. **Quantities and Sites.** This category comprises three indicators: Quantities of Nuclear Materials, Sites and Transportation, and Materials Production and Elimination Trends.
2. **Security and Control Measures.** This category comprises six indicators: On-site Physical Protection, Control and Accounting Procedures, Insider Threat Prevention, Physical Security during Transport, Response Capabilities, and Cybersecurity.
3. **Global Norms.** This category comprises three indicators: International Legal Commitments, Voluntary Commitments, and International Assurances.
4. **Domestic Commitments and Capacity.** This category comprises four indicators: UN Security Council Resolution (UNSCR) 1540 Implementation, Domestic Nuclear Materials Security Legislation, Safeguards Adherence and Compliance, and Independent Regulatory Agency.
5. **Risk Environment.** This category comprises four indicators: Political Stability, Effective Governance, Pervasiveness of Corruption, and Group(s) Interested in Illicitly Acquiring Materials.

Each indicator within the five categories contains up to eight underlying subindicators. Principal components analysis (PCA) was also conducted on the model to ensure the relevance and robustness of the chosen indicators and categories. The use of PCA is described on page 24.

The categories, indicators, and subindicators are as follows:

1	**QUANTITIES AND SITES**
1.1	**Quantities of Nuclear Materials**
1.1.1	Quantities of nuclear materials
1.2	**Sites and Transportation**
1.2.1	Number of sites
1.2.2	Bulk processing facility
1.2.3	Frequency of materials transport
1.3	**Material Production and Elimination Trends**
1.3.1	Material production/elimination trends
2	**SECURITY AND CONTROL MEASURES**
2.1	**On-site Physical Protection**
2.1.1	Mandatory physical protection
2.1.2	On-site reviews of security
2.1.3	Design Basis Threat (DBT)
2.1.4	Security responsibilities and accountabilities
2.1.5	Performance-based program
2.2	**Control and Accounting Procedures**
2.2.1	Legal and regulatory basis for material control and accounting (MC&A)
2.2.2	Measurement methods
2.2.3	Inventory record
2.2.4	Material Balance Area(s)
2.2.5	Control measures
2.3	**Insider Threat Prevention**
2.3.1	Personnel vetting
2.3.2	Frequency of personnel vetting
2.3.3	Reporting
2.3.4	Surveillance
2.4	**Physical Security During Transport**
2.4.1	Physical security during transport

2.5	**Response Capabilities**
2.5.1	Emergency response capabilities
2.5.2	Armed response capabilities
2.5.3	Law enforcement response training
2.5.4	Nuclear infrastructure protection plan
2.6	**Cybersecurity***
2.6.1	Mandatory cybersecurity
2.6.2	Critical digital asset protection
2.6.3	Cybersecurity DBT
2.6.4	Cybersecurity assessments
2.6.5	Cyber incident response plan*
3	**GLOBAL NORMS**
3.1	**International Legal Commitments**
3.1.1	Convention on the Physical Protection of Nuclear Material (CPPNM)
3.1.2	2005 Amendment to the CPPNM
3.1.3	International Convention for the Suppression of Acts of Nuclear Terrorism (ICSANT)
3.2	**Voluntary Commitments**
3.2.1	International Atomic Energy Agency (IAEA) membership
3.2.2	Proliferation Security Initiative (PSI) membership
3.2.3	Global Initiative to Combat Nuclear Terrorism (GICNT) membership
3.2.4	Global Partnership Against the Spread of Weapons and Materials of Mass Destruction membership
3.2.5	World Institute for Nuclear Security (WINS) contributions
3.2.6	IAEA Nuclear Security Fund contributions
3.2.7	Bilateral or multilateral assistance
3.2.8	Centers of Excellence
3.3	**International Assurances**
3.3.1	Published regulations and reports
3.3.2	Public declarations/reports about nuclear materials
3.3.3	Review of security arrangements
4	**DOMESTIC COMMITMENTS AND CAPACITY**
4.1	**UN Security Council Resolution (UNSCR) 1540 Implementation**
4.1.1	UNSCR 1540 reporting
4.1.2	Extent of UNSCR 1540 implementation
4.2	**Domestic Nuclear Materials Security Legislation**
4.2.1	CPPNM implementation authority
4.2.2	National legal framework for CPPNM
4.3	**Safeguards Adherence and Compliance**
4.3.1	IAEA safeguards agreement (excluding Additional Protocol)
4.3.2	IAEA Additional Protocol
4.3.3	Facility exclusion from safeguards
4.3.4	Safeguards violations
4.4	**Independent Regulatory Agency**
4.4.1	Independent regulatory agency
5	**RISK ENVIRONMENT**
5.1	**Political Stability**
5.1.1	Social unrest
5.1.2	Orderly transfers of power
5.1.3	International disputes or tensions
5.1.4	Armed conflict
5.1.5	Violent demonstrations or violent civil or labor unrest
5.2	**Effective Governance**
5.2.1	Effectiveness of the political system
5.2.2	Quality of the bureaucracy
5.3	**Pervasiveness of Corruption**
5.3.1	Pervasiveness of corruption
5.4	**Group(s) Interested in Illicitly Acquiring Materials**
5.4.1	Group(s) interested in illicitly acquiring materials

* Indicates new or revised indicator or subindicator. See the section on *Comparison between the 2016 and 2018 NTI Indices* for more detail about these new and revised indicators or subindicators.

Theft Ranking for Countries without Materials

Countries without weapons-usable nuclear materials are assessed against a subset of the categories, indicators, and subindicators used for research about the countries that possess such materials. The overall score (0–100) for countries in this second ranking is a weighted sum of the three categories, where each is scored on a scale of 0–100, where 100 represents the most favorable and 0 represents the least favorable nuclear security conditions possible as measured by the NTI Index criteria. Each category is normalized on the basis of sums of underlying indicators and subindicators and a weight is then applied. Weights reflect the relative importance and relevance of each indicator and category based on input from the International Panel of Experts. Weights in the model are dynamic and can be changed by users.

The three categories of the theft ranking for countries without materials are as follows:

- **Global Norms.** This category comprises two indicators: International Legal Commitments and Voluntary Commitments.
- **Domestic Commitments and Capacity.** This category comprises three indicators: UNSCR 1540 Implementation, Domestic Nuclear Materials Security Legislation, and Safeguards Adherence and Compliance.
- **Risk Environment.** This category comprises four indicators: Political Stability, Effective Governance, Pervasiveness of Corruption, and Group(s) Interested in Illicitly Acquiring Materials.

Each indicator within the three categories contains one to eight underlying subindicators.

The categories, indicators, and subindicators are as follows:

3	**GLOBAL NORMS**
3.1	**International Legal Commitments**
3.1.1	Convention on the Physical Protection of Nuclear Material (CPPNM)
3.1.2	2005 Amendment to the CPPNM
3.1.3	International Convention for the Suppression of Acts of Nuclear Terrorism (ICSANT)
3.2	**Voluntary Commitments**
3.2.1	International Atomic Energy Agency (IAEA) membership
3.2.2	Proliferation Security Initiative (PSI) membership
3.2.3	Global Initiative to Combat Nuclear Terrorism (GICNT) membership
3.2.4	Global Partnership Against the Spread of Weapons and Materials of Mass Destruction membership
3.2.5	World Institute for Nuclear Security (WINS) contributions
3.2.6	IAEA Nuclear Security Fund contributions
3.2.7	Bilateral or multilateral assistance
3.2.8	Centers of Excellence
4	**DOMESTIC COMMITMENTS AND CAPACITY**
4.1	**UN Security Council Resolution (UNSCR) 1540 Implementation**
4.1.1	UNSCR 1540 reporting
4.1.2	Extent of UNSCR 1540 implementation
4.2	**Domestic Nuclear Materials Security Legislation**
4.2.1	CPPNM implementation authority
4.2.2	National legal framework for CPPNM
4.3	**Safeguards Adherence and Compliance**
4.3.1	IAEA safeguards agreement (excluding Additional Protocol)
4.3.2	IAEA Additional Protocol
4.3.3	Safeguards violations

5	RISK ENVIRONMENT
5.1	**Political Stability**
5.1.1	Social unrest
5.1.2	Orderly transfers of power
5.1.3	International disputes or tensions
5.1.4	Armed conflict
5.1.5	Violent demonstrations or violent civil or labor unrest
5.2	**Effective Governance**
5.2.1	Effectiveness of the political system
5.2.2	Quality of the bureaucracy
5.3	**Pervasiveness of Corruption**
5.3.1	Pervasiveness of corruption
5.4	**Group(s) Interested in Illicitly Acquiring Materials**
5.4.1	Group(s) interested in illicitly acquiring materials

Sabotage Ranking

The overall score (0–100) for each country in the sabotage ranking is a weighted sum of the five categories. Each category is scored on a scale of 0–100, where 100 represents the most favorable and 0 represents the least favorable nuclear security conditions possible in the sabotage ranking. A score of 100 in the sabotage ranking does not indicate that a country has perfect nuclear security conditions and likewise a score of 0 does not mean that a country has no security; instead, the scores of 100 and 0 represent the highest or lowest possible score, respectively, as measured by the ranking criteria. Each category is normalized on the basis of the sums of underlying indicators and subindicators and a weight is then applied. Weights are based on input from the International Panel of Experts and reflect the relative importance and relevance of each indicator and category. Weights in the model, however, are dynamic and can be changed by users.

The five categories of the sabotage rankings are as follows:

1. **Number of Sites.** This category comprises one indicator: Number of Sites.
2. **Security and Control Measures.** This category comprises five indicators: On-site Physical Protection, Control and Accounting Procedures, Insider Threat Prevention, Response Capabilities, and Cybersecurity.
3. **Global Norms.** This category comprises three indicators: International Legal Commitments, Voluntary Commitments, and International Assurances.
4. **Domestic Commitments and Capacity.** This category comprises three indicators: UN Security Council Resolution (UNSCR) 1540 Implementation, Domestic Nuclear Materials Security Legislation, and Independent Regulatory Agency.
5. **Risk Environment.** This category comprises four indicators: Political Stability, Effective Governance, Pervasiveness of Corruption, and Group(s) Interested in Committing Acts of Nuclear Terrorism.

Each indicator within the five categories contains up to seven underlying subindicators. Principal components analysis (PCA) was also conducted on the model to ensure the relevance and robustness of the chosen indicators and categories. The use of PCA is described on page 26.

The categories, indicators, and subindicators are as follows:[7]

1	**NUMBER OF SITES**
1.1	**Number of sites†**
1.1.1	Number of sites†
2	**SECURITY AND CONTROL MEASURES**
2.1	**On-site Physical Protection**
2.1.1	Mandatory physical protection
2.1.2	On-site reviews of security
2.1.3	Design Basis Threat (DBT)
2.1.4	Security responsibilities and accountabilities
2.1.5	Performance-based program
2.2	**Control and Accounting Procedures**
2.2.1	Legal and regulatory basis for material control and accounting (MC&A)
2.2.2	Radiological consequences (materials)#
2.2.3	Radiological consequences (equipment, systems, and devices)#
2.2.4	Control measures†
2.2.5	Access control#
2.3	**Insider Threat Prevention**
2.3.1	Personnel vetting
2.3.2	Frequency of personnel vetting
2.3.3	Reporting
2.3.4	Surveillance†
2.4	**Response Capabilities**
2.4.1	Emergency response capabilities
2.4.2	Armed response capabilities†
2.4.3	Law enforcement response training
2.4.4	Nuclear infrastructure protection plan
2.5	**Cybersecurity***
2.5.1	Mandatory cybersecurity
2.5.2	Critical digital asset protection
2.5.3	Cybersecurity DBT
2.5.4	Cybersecurity assessments
2.5.5	Cyber incident response plan*
3	**GLOBAL NORMS**
3.1	**International Legal Commitments**
3.1.1	Convention on the Physical Protection of Nuclear Material (CPPNM)
3.1.2	2005 Amendment to the CPPNM
3.1.3	International Convention for the Suppression of Acts of Nuclear Terrorism (ICSANT)
3.1.4	Convention on Nuclear Safety#
3.2	**Voluntary Commitments**
3.2.1	International Atomic Energy Agency (IAEA) membership
3.2.2	Global Initiative to Combat Nuclear Terrorism (GICNT) membership
3.2.3	Global Partnership Against the Spread of Weapons and Materials of Mass Destruction membership
3.2.4	World Institute for Nuclear Security (WINS) contributions
3.2.5	IAEA Nuclear Security Fund contributions
3.2.6	Bilateral or multilateral assistance
3.2.7	Centers of Excellence
3.3	**International Assurances**
3.3.1	Published regulations and reports
3.3.2	Review of security arrangements

[7] There are differences between the theft ranking for countries with materials framework and the sabotage ranking framework. In some cases, though indicators in both models have the same names, different aspects of nuclear security are being measured (e.g., the number of sites subindicator defines sites differently). Additionally, there are some indicators and subindicators that have the same indicator question and the same scoring criteria, but owing to differences in the theft ranking framework and the sabotage ranking framework, have different indicator and subindicator numbers. For a more extensive discussion of the differences between the theft ranking and the sabotage ranking, please see the section entitled *Comparison between the Theft Ranking for Countries with Materials and Sabotage Indices* and the indicator frameworks at the end of this EIU Methodology appendix.

4	**DOMESTIC COMMITMENTS AND CAPACITY**
4.1	**UN Security Council Resolution (UNSCR) 1540 Implementation**
4.1.1	UNSCR 1540 reporting
4.1.2	Extent of UNSCR 1540 implementation†
4.2	**Domestic Nuclear Security Legislation**
4.2.1	CPPNM implementation authority
4.2.2	National legal framework for CPPNM
4.2.3	Convention on Nuclear Safety report#
4.3	**Independent Regulatory Agency**
4.3.1	Independent regulatory agency
5	**RISK ENVIRONMENT**
5.1	**Political Stability**
5.1.1	Social unrest
5.1.2	Orderly transfers of power
5.1.3	International disputes or tensions
5.1.4	Armed conflict
5.1.5	Violent demonstrations or violent civil or labor unrest
5.2	**Effective Governance**
5.2.1	Effectiveness of the political system
5.2.2	Quality of the bureaucracy
5.3	**Pervasiveness of Corruption**
5.3.1	Pervasiveness of corruption
5.4	**Group(s) Interested in Committing Acts of Nuclear Terrorism†**
5.4.1	Group(s) interested in committing acts of nuclear terrorism†

# Denotes indicators and subindicators that are unique to the sabotage ranking.

† Denotes indicators and subindicators that are also in the theft ranking but have been altered.

* Denotes indicators and subindicators that are new to the sabotage ranking.

INDEX CONSTRAINTS AND OTHER IMPORTANT FACTORS

In creating the NTI Index, the EIU relied on publicly available sources, such as laws and regulations. This research approach has the benefit of creating a fully transparent and repeatable methodology, but it also presents some challenges. For example, regulations and codes of practice for nuclear security are sometimes classified. In cases where a country was particularly non-transparent, scores were assigned based on a proxy indicator. The absence of information on nuclear security reduces public and international understanding of the security measures countries are taking; thus, it is appropriate for those countries that do not make their regulations publicly available to receive low scores.

Although facility-level assessments would provide important "ground-truth" information, this level of granularity is not currently possible because of the sensitive nature of specific security arrangements. As a result, the NTI Index relies instead on the assumption that a country with the appropriate laws and regulations in place is more likely to have sound security procedures at each nuclear facility than a country without appropriate laws and regulations.

Finally, it should be noted that the NTI Index includes "indicators" of security conditions and not the complete set of good security practices that nuclear faculties should employ to protect against theft of weapons-usable nuclear materials or sabotage. For example, information regarding the types of locking mechanisms, surveillance systems, thickness of walls, and so forth, is not publicly available for security reasons. The exclusion of specific security practices from the NTI Index does not reflect their lack of importance, but instead reflects the research constraints of the NTI Index.

METHODOLOGY

General

The NTI Index comprises categories that are related to the nuclear security conditions for each country. The NTI Index differentiates between three sets of countries: (a) countries with one kilogram or more of weapons-usable nuclear materials (countries with materials); (b) countries with less than one kilogram of or no weapons-usable nuclear materials (countries without materials); and (c) countries with nuclear facilities the sabotage of which could result in a significant radiological release with serious off-site health consequences. Twenty of the countries with materials and 24 countries and Taiwan without materials are also included in the sabotage ranking.

The scope of the NTI Index theft rankings is limited to highly enriched uranium (HEU), including spent fuel, separated plutonium, and plutonium in unirradiated mixed oxide fuel (MOX). Countries with materials are assessed across all five categories, countries without materials are assessed across three categories, and countries with nuclear facilities at risk of sabotage are assessed across five categories.

To score the indicators for the 2018 NTI Index, the research team gathered data from the following sources:

- Primary legal texts and legal reports
- Government publications and reports
- Academic publications and reports
- Websites of government authorities, international organizations, and non-governmental organizations
- Interviews with experts
- EIU proprietary country rankings and reports (specifically "Risk Briefing" and the "Business Environment Ranking")
- Local and international news media reports

See *Selected Bibliography* for more information about central sources.

By reviewing recent reports pertaining to quantities of nuclear materials and by taking into account recent developments, the EIU identified the following 22 countries[8] (listed in alphabetical order) as having one kilogram or more of HEU (including spent fuel), separated plutonium, or plutonium content in unirradiated MOX:

Australia
Belarus
Belgium
Canada
China
France
Germany
India
Iran
Israel
Italy
Japan
Kazakhstan
Netherlands
North Korea
Norway
Pakistan
Russia
South Africa
Switzerland
United Kingdom
United States

The 2018 NTI Index also assesses the following 154 countries (listed in alphabetical order) that have less than one kilogram of weapons-usable nuclear materials or no weapons-usable nuclear materials:

Afghanistan
Albania
Algeria
Angola
Argentina
Armenia
Austria
Azerbaijan
Bahamas
Bahrain
Bangladesh
Barbados
Belize
Benin
Bhutan
Bolivia
Bosnia and Herzegovina
Botswana
Brazil
Brunei
Bulgaria
Burkina Faso
Burundi
Cambodia
Cameroon
Cape Verde
Central African Republic
Chad
Chile
Colombia
Comoros
Congo (Democratic Republic)
Congo (Brazzaville)
Costa Rica
Cote d'Ivoire
Croatia
Cuba
Cyprus
Czech Republic
Denmark
Djibouti
Dominican Republic
Ecuador
Egypt
El Salvador
Equatorial Guinea
Eritrea
Estonia
Ethiopia

[8] Argentina and Poland were removed from the 2018 theft ranking for countries with materials and placed in the 2018 theft ranking for countries without materials, because they no longer have one kilogram or more of HEU (including spent fuel), separated plutonium, or plutonium content in unirradiated MOX. They remain in the Sabotage Index.

Fiji
Finland
Gabon
Gambia
Georgia
Ghana
Greece
Guatemala
Guinea
Guinea-Bissau
Guyana
Haiti
Honduras
Hungary
Iceland
Indonesia
Iraq
Ireland
Jamaica
Jordan
Kenya
Kuwait
Kyrgyz Republic
Laos
Latvia
Lebanon
Lesotho
Liberia
Libya
Lithuania
Luxembourg
Macedonia
Madagascar
Malawi
Malaysia
Mali
Malta
Mauritania
Mauritius
Mexico
Moldova
Mongolia
Montenegro
Morocco
Mozambique
Myanmar
Namibia
Nepal
New Zealand
Nicaragua
Niger
Nigeria
Oman
Panama
Papua New Guinea
Paraguay
Peru
Philippines
Poland
Portugal
Qatar
Romania
Rwanda
Samoa
Sao Tome and Principe
Saudi Arabia
Senegal
Serbia
Seychelles
Sierra Leone
Singapore
Slovakia
Slovenia
Solomon Islands
Somalia
South Korea
Spain
Sri Lanka
Sudan
Suriname
Swaziland
Sweden
Syria
Taiwan
Tajikistan
Tanzania
Thailand
Timor-Leste
Togo
Tonga
Trinidad and Tobago
Tunisia
Turkey
Turkmenistan
Uganda
Ukraine
United Arab Emirates
Uruguay
Uzbekistan
Vanuatu
Venezuela
Vietnam
Yemen
Zambia
Zimbabwe

Finally, the 2018 NTI Index also assesses the following 44 countries and Taiwan (listed in alphabetical order) with nuclear facilities, the sabotage of which could result in a significant radiological release with serious off-site health consequences:

Algeria
Argentina
Armenia
Australia
Bangladesh
Belgium
Brazil
Bulgaria
Canada
Chile
China
Czech Republic
Egypt
Finland
France
Germany
Hungary
India
Indonesia
Iran
Israel
Japan
Kazakhstan
Mexico
Morocco
Netherlands
North Korea
Norway
Pakistan
Peru
Poland
Romania
Russia
Slovakia
Slovenia
South Africa
South Korea
Spain
Sweden
Switzerland
Taiwan
Ukraine
United Kingdom
United States
Uzbekistan

Note that 20 of the countries in the theft ranking for countries with materials and 24 of the countries in the theft ranking for countries without materials, along with Taiwan, are also included in the sabotage ranking.

Data Review and Confirmation Process

After researching the 20 indicators in the theft ranking for countries with materials and the 16 indicators in the sabotage ranking and after gathering all relevant information, NTI and the EIU provided all 46 countries and Taiwan that are included in the theft ranking for countries with materials, the sabotage ranking, or both with an opportunity to review and comment on the EIU's preliminary results. The purpose of this data review and confirmation process was to ensure the accuracy of the 2018 NTI Index data, given that much of the research for the index involved subjects for which information is not always publicly available. The research team also recognized that some countries might be willing, upon

request, to provide the EIU with more detailed information than is readily available to the public.

To make this process as simple as possible, the EIU developed documents that presented the data for most of the 2018 NTI Index indicators. Not all indicators, however, were subjected to this confirmation process: for instance, the EIU did not include data that were easily verifiable from publicly available sources (e.g., treaty ratification status) or that were drawn from proprietary EIU databases assessing political stability, effective governance, and corruption.

The EIU created three different data review and confirmation forms: one for countries that are included in both the theft ranking for countries with materials and the sabotage ranking (44 subindicators); one for countries that are included in only the sabotage ranking (33 subindicators); and one for countries that are included in only the theft ranking for countries with materials (40 subindicators).

The data review and confirmation form listed the range of possible answers for each subindicator and identified the answer the EIU assigned for the country. The forms allowed the reviewer to either agree or disagree with the answer, and they provided a comment box in which the reviewer could offer an alternative answer and justification. The EIU used the submitted responses to reevaluate its scores. In some cases, respondents provided information that resulted in the EIU lowering a country's score, whereas in other cases, scores were raised. When the responses were unclear, the EIU contacted individuals for clarification. Country representatives had four months—from mid-February to June 15, 2018—to respond to the data review and confirmation request. One country was given until July 18, 2018, to respond.

Of the 46 countries and Taiwan, 26 responded to the data review and confirmation request: Argentina, Australia, Belarus, Belgium, Canada, Chile, the Czech Republic, Finland, France, Germany, Hungary, Italy, Japan, Mexico, the Netherlands, Norway, Peru, Romania, Slovenia, South Korea, Sweden, Switzerland, Taiwan, Ukraine, the United Kingdom, and the United States.[9]

Technical Advisors

In addition to the International Panel of Experts, the EIU received expert guidance from technical advisors throughout the research process. These technical advisors helped the EIU modify and refine indicators to capture key elements of nuclear security and provided insights into the more technical parts of the research. The following technical advisors were consulted throughout the research process:

- **Rob Hoffman**, Executive Consultant for International Nuclear Cyber Security, Idaho National Laboratory; former Nuclear Cyber Security consultant at the IAEA.
- **Dmitry Kovchegin**, independent nuclear security consultant.

Data Modeling

Data were collected across 61 subindicators for the theft ranking for countries with materials, 27 subindicators for the theft ranking for countries without materials, and 52 subindicators for countries in the sabotage ranking. The subindicators range from binomial observations (0,1) to subindicators with nine possible scoring options. Each subindicator is constructed so that a higher value is associated with more favorable nuclear security conditions. For example, for the subindicator Number of Sites in the theft ranking for countries with materials, a country with 100 or more sites with nuclear materials is assigned a value of 0, whereas a country with one site is assigned a value of 3. The sum of the subindicator values determines the value of the indicator. Countries in the theft ranking for countries with materials are assessed across 20 indicators, countries in the theft ranking for countries without materials are assessed across 9 indicators, and countries in the sabotage ranking are assessed across 16 indicators.

[9] Of the 25 countries and Taiwan that responded to the data confirmation, 11 were included in both the theft ranking for countries with materials and the sabotage ranking: Australia, Belgium, Canada, France, Germany, Japan, the Netherlands, Norway, Switzerland, the United Kingdom, and the United States. The two countries that are included only in the theft ranking for countries with materials both responded: Belarus and Italy. The remaining 13 responses were from 12 countries and Taiwan that are included only in the sabotage ranking: Argentina, Chile, the Czech Republic, Finland, Hungary, Mexico, Peru, Romania, Slovenia, South Korea, Sweden, Taiwan, and Ukraine.

Theft Ranking for Countries with Materials

The following table lists the scoring scheme for each component of the theft ranking for countries with materials:

1	**QUANTITIES AND SITES**	**Scored 0–100 (where 100 = most favorable nuclear materials security conditions)**
1.1	**Quantities of Nuclear Materials**	**Scored 0–8 (where 8 = most favorable nuclear materials security conditions)**
1.1.1	Quantities of nuclear materials	Scored 0–8
1.2	**Sites and Transportation**	**Scored 0–6 (where 6 = most favorable nuclear materials security conditions)**
1.2.1	Number of sites	Scored 0–3
1.2.2	Bulk processing facility	Scored 0–1
1.2.3	Frequency of materials transport	Scored 0–2
1.3	**Material Production and Elimination Trends**	**Scored 0–4 (where 4 = most favorable nuclear materials security conditions)**
1.3.1	Material production/elimination trends	Scored 0–4
2	**SECURITY AND CONTROL MEASURES**	**Scored 0–100 (where 100 = most favorable nuclear materials security conditions)**
2.1	**On-site Physical Protection**	**Scored 0–5 (where 5 = most favorable nuclear materials security conditions)**
2.1.1	Mandatory physical protection	Scored 0–1
2.1.2	On-site reviews of security	Scored 0–1
2.1.3	Design Basis Threat (DBT)	Scored 0–1
2.1.4	Security responsibilities and accountabilities	Scored 0–1
2.1.5	Performance-based program	Scored 0–1
2.2	**Control and Accounting Procedures**	**Scored 0–7 (where 7 = most favorable nuclear materials security conditions)**
2.2.1	Legal and regulatory basis for material control and accounting (MC&A)	Scored 0–2
2.2.2	Measurement methods	Scored 0–1
2.2.3	Inventory record	Scored 0–1
2.2.4	Material Balance Area(s)	Scored 0–1
2.2.5	Control measures	Scored 0–2
2.3	**Insider Threat Prevention**	**Scored 0–9 (where 9 = most favorable nuclear materials security conditions)**
2.3.1	Personnel vetting	Scored 0–3
2.3.2	Frequency of personnel vetting	Scored 0–3
2.3.3	Reporting	Scored 0–1

2.3.4	Surveillance	Scored 0–2
2.4	**Physical Security During Transport**	**Scored 0–2 (where 2 = most favorable nuclear materials security conditions)**
2.4.1	Physical security during transport	Scored 0–2
2.5	**Response Capabilities**	**Scored 0–7 (where 7 = most favorable nuclear materials security conditions)**
2.5.1	Emergency response capabilities	Scored 0–3
2.5.2	Armed response capabilities	Scored 0–1
2.5.3	Law enforcement response training	Scored 0–1
2.5.4	Nuclear infrastructure protection plan	Scored 0–2
2.6	**Cybersecurity**	**Scored 0–5 (where 5 = most favorable nuclear materials security conditions)**
2.6.1	Mandatory cybersecurity	Scored 0–1
2.6.2	Critical digital asset protection	Scored 0–1
2.6.3	Cybersecurity DBT	Scored 0–1
2.6.4	Cybersecurity assessments	Scored 0–1
2.6.5	Cyber incident response plan	Scored 0–1
3	**GLOBAL NORMS**	**Scored 0–100 (where 100 = most favorable nuclear materials security conditions)**
3.1	**International Legal Commitments**	**Scored 0–5 (where 5 = most favorable nuclear materials security conditions)**
3.1.1	Convention on the Physical Protection of Nuclear Material (CPPNM)	Scored 0–2
3.1.2	2005 Amendment to the CPPNM	Scored 0–1
3.1.3	International Convention for the Suppression of Acts of Nuclear Terrorism (ICSANT)	Scored 0–2
3.2	**Voluntary Commitments**	**Scored 0–5 (where 5 = most favorable nuclear materials security conditions)**
3.2.1	International Atomic Energy Agency (IAEA) membership	Scored 0–1
3.2.2	Proliferation Security Initiative (PSI) membership	Scored 0–1
3.2.3	Global Initiative to Combat Nuclear Terrorism (GICNT) membership	Scored 0–1
3.2.4	Global Partnership Against the Spread of Weapons and Materials of Mass Destruction membership	Scored 0–1
3.2.5	World Institute for Nuclear Security (WINS) contributions	Scored 0–1
3.2.6	IAEA Nuclear Security Fund contributions	Scored 0–1
3.2.7	Bilateral or multilateral assistance	Scored 0–1
3.2.8	Centers of Excellence	Scored 0–1

3.3	**International Assurances**	**Scored 0–5 (where 5 = most favorable nuclear materials security conditions)**
3.3.1	Published regulations and reports	Scored 0–2
3.3.2	Public declarations and reports about nuclear materials	Scored 0–1
3.3.3	Review of security arrangements	Scored 0–2
4	**DOMESTIC COMMITMENTS AND CAPACITY**	**Scored 0–100 (where 100 = most favorable nuclear materials security conditions)**
4.1	**UN Security Council Resolution (UNSCR) 1540 Implementation**	**Scored 0–5 (where 5 = most favorable nuclear materials security conditions)**
4.1.1	UNSCR 1540 reporting	Scored 0–1
4.1.2	Extent of UNSCR 1540 implementation	Scored 0–4
4.2	**Domestic Nuclear Materials Security Legislation**	**Scored 0–2 (where 2 = most favorable nuclear materials security conditions)**
4.2.1	CPPNM implementation authority	Scored 0–1
4.2.2	National legal framework for CPPNM	Scored 0–1
4.3	**Safeguards Adherence and Compliance**	**Scored 0–6 (where 6 = most favorable nuclear materials security conditions)**
4.3.1	IAEA safeguards agreement (excluding Additional Protocol)	Scored 0–2
4.3.2	IAEA Additional Protocol	Scored 0–1
4.3.3	Facility exclusion from safeguards	Scored 0–1
4.3.4	Safeguards violations	Scored 0–2
4.4	**Independent Regulatory Agency**	**Scored 0–1 (where 1 = most favorable nuclear materials security conditions)**
4.4.1	Independent regulatory agency	Scored 0–1
5	**RISK ENVIRONMENT**	**Scored 0–100 (where 100 = most favorable nuclear materials security conditions)**
5.1	**Political Stability**	**Scored 0–20 (where 20 = most favorable security conditions)**
5.1.1	Social unrest	Scored 0–4
5.1.2	Orderly transfers of power	Scored 0–4
5.1.3	International disputes or tensions	Scored 0–4
5.1.4	Armed conflict	Scored 0–4
5.1.5	Violent demonstrations or violent civil or labor unrest	Scored 0–4
5.2	**Effective Governance**	**Scored 0–8 (where 8 = most favorable nuclear materials security conditions)**
5.2.1	Effectiveness of the political system	Scored 0–4
5.2.2	Quality of the bureaucracy	Scored 0–4

5.3	**Pervasiveness of Corruption**	**Scored 0–4 (where 4 = most favorable security conditions)**
5.3.1	Pervasiveness of corruption	Scored 0–4
5.4	**Group(s) Interested in Illicitly Acquiring Materials**	**Scored 0–2 (where 2 = most favorable security conditions)**
5.4.1	Group(s) interested in illicitly acquiring materials	Scored 0–2

Theft Ranking for Countries without Materials

The following table lists the scoring scheme for each component of the theft ranking for countries without materials:

3	**GLOBAL NORMS**	**Scored 0–100 (where 100 = most favorable nuclear materials security conditions)**
3.1	**International Legal Commitments**	**Scored 0–5 (where 5 = most favorable nuclear materials security conditions)**
3.1.1	Convention on the Physical Protection of Nuclear Material (CPPNM)	Scored 0–2
3.1.2	2005 Amendment to the CPPNM	Scored 0–1
3.1.3	International Convention for the Suppression of Acts of Nuclear Terrorism (ICSANT)	Scored 0–2
3.2	**Voluntary Commitments**	**Scored 0–5 (where 5 = most favorable nuclear materials security conditions)**
3.2.1	International Atomic Energy Agency (IAEA) membership	Scored 0–1
3.2.2	Proliferation Security Initiative (PSI) membership	Scored 0–1
3.2.3	Global Initiative to Combat Nuclear Terrorism (GICNT) membership	Scored 0–1
3.2.4	Global Partnership Against the Spread of Weapons and Materials of Mass Destruction membership	Scored 0–1
3.2.5	World Institute for Nuclear Security (WINS) contributions	Scored 0–1
3.2.6	IAEA Nuclear Security Fund contributions	Scored 0–1
3.2.7	Bilateral or multilateral assistance	Scored 0–1
3.2.8	Centers of Excellence	Scored 0–1
4	**DOMESTIC COMMITMENTS AND CAPACITY**	**Scored 0–100 (where 100 = most favorable nuclear materials security conditions)**
4.1	**UN Security Council Resolution (UNSCR) 1540 Implementation**	**Scored 0–5 (where 5 = most favorable nuclear materials security conditions)**
4.1.1	UNSCR 1540 reporting	Scored 0–1
4.1.2	Extent of UNSCR 1540 implementation	Scored 0–4

4.2	**Domestic Nuclear Materials Security Legislation**	**Scored 0–2 (where 2 = most favorable nuclear materials security conditions)**
4.2.1	CPPNM implementation authority	Scored 0–1
4.2.2	National legal framework for CPPNM	Scored 0–1
4.3	**Safeguards Adherence and Compliance**	**Scored 0–6 (where 6 = most favorable nuclear materials security conditions)**
4.3.1	IAEA safeguards agreement (excluding Additional Protocol)	Scored 0–3
4.3.2	IAEA Additional Protocol	Scored 0–1
4.3.4	Safeguards violations	Scored 0–2
5	**RISK ENVIRONMENT**	**Scored 0–100 (where 100 = most favorable nuclear materials security conditions)**
5.1	**Political Stability**	**Scored 0–20 (where 20 = most favorable security conditions)**
5.1.1	Social unrest	Scored 0–4
5.1.2	Orderly transfers of power	Scored 0–4
5.1.3	International disputes or tensions	Scored 0–4
5.1.4	Armed conflict	Scored 0–4
5.1.5	Violent demonstrations or violent civil or labor unrest	Scored 0–4
5.2	**Effective Governance**	**Scored 0–8 (where 8 = most favorable nuclear materials security conditions)**
5.2.1	Effectiveness of the political system	Scored 0–4
5.2.2	Quality of the bureaucracy	Scored 0–4
5.3	**Pervasiveness of Corruption**	**Scored 0–4 (where 4 = most favorable security conditions)**
5.3.1	Pervasiveness of corruption	Scored 0–4
5.4	**Group(s) Interested in Illicitly Acquiring Materials**	**Scored 0–2 (where 2 = most favorable security conditions)**
5.4.1	Group(s) interested in illicitly acquiring materials	Scored 0–2

Sabotage Ranking

The following table lists the scoring scheme for each component of the sabotage ranking:

1	**NUMBER OF SITES**	**Scored 0–100 (where 100 = most favorable nuclear materials security conditions)**
1.1	**Number of sites**	**Scored 0–5 (where 5 = most favorable nuclear materials security conditions)**
1.1.1	Number of sites	Scored 0–5
2	**SECURITY AND CONTROL MEASURES**	**Scored 0–100 (where 100 = most favorable nuclear materials security conditions)**
2.1	**On-site Physical Protection**	**Scored 0–5 (where 5 = most favorable nuclear materials security conditions)**
2.1.1	Mandatory physical protection	Scored 0–1
2.1.2	On-site reviews of security	Scored 0–1
2.1.3	Design Basis Threat (DBT)	Scored 0–1
2.1.4	Security responsibilities and accountabilities	Scored 0–1
2.1.5	Performance-based program	Scored 0–1
2.2	**Control and Accounting Procedures**	**Scored 0–7 (where 7 = most favorable nuclear materials security conditions)**
2.2.1	Legal and regulatory basis for material control and accounting (MC&A)	Scored 0–2
2.2.2	Radiological consequences (materials)	Scored 0–1
2.2.3	Radiological consequences (equipment, systems, and devices)	Scored 0–1
2.2.4	Control measures	Scored 0–2
2.2.5	Access control	Scored 0–1
2.3	**Insider Threat Prevention**	**Scored 0–9 (where 9 = most favorable nuclear materials security conditions)**
2.3.1	Personnel vetting	Scored 0–3
2.3.2	Frequency of personnel vetting	Scored 0–3
2.3.3	Reporting	Scored 0–1
2.3.4	Surveillance	Scored 0–2
2.4	**Response Capabilities**	**Scored 0–7 (where 7 = most favorable nuclear materials security conditions)**
2.4.1	Emergency response capabilities	Scored 0–3
2.4.2	Armed response capabilities	Scored 0–1
2.4.3	Law enforcement response training	Scored 0–1
2.4.4	Nuclear infrastructure protection plan	Scored 0–2

2.5	**Cybersecurity**	**Scored 0–5 (where 5 = most favorable nuclear materials security conditions)**
2.5.1	Mandatory cybersecurity	Scored 0–1
2.5.2	Critical digital asset protection	Scored 0–1
2.5.3	Cybersecurity DBT	Scored 0–1
2.5.4	Cybersecurity assessments	Scored 0–1
2.5.5	Cyber incident response plan	Scored 0–1
3	**GLOBAL NORMS**	**Scored 0–100 (where 100 = most favorable nuclear materials security conditions)**
3.1	**International Legal Commitments**	**Scored 0–7 (where 7 = most favorable nuclear materials security conditions)**
3.1.1	Convention on the Physical Protection of Nuclear Material (CPPNM)	Scored 0–2
3.1.2	2005 Amendment to the CPPNM	Scored 0–1
3.1.3	International Convention for the Suppression of Acts of Nuclear Terrorism (ICSANT)	Scored 0–2
3.1.4	Convention on Nuclear Safety	Scored 0–2
3.2	**Voluntary Commitments**	**Scored 0–5 (where 5 = most favorable nuclear materials security conditions)**
3.2.1	International Atomic Energy Agency (IAEA) membership	Scored 0–1
3.2.2	Global Initiative to Combat Nuclear Terrorism (GICNT) membership	Scored 0–1
3.2.3	Global Partnership Against the Spread of Weapons and Materials of Mass Destruction membership	Scored 0–1
3.2.4	World Institute for Nuclear Security (WINS) contributions	Scored 0–1
3.2.5	IAEA Nuclear Security Fund contributions	Scored 0–1
3.2.6	Bilateral or multilateral assistance	Scored 0–1
3.2.7	Centers of Excellence	Scored 0–1
3.3	**International Assurances**	**Scored 0–4 (where 4 = most favorable nuclear materials security conditions)**
3.3.1	Published regulations and reports	Scored 0–2
3.3.2	Review of security arrangements	Scored 0–2
4	**DOMESTIC COMMITMENTS AND CAPACITY**	**Scored 0–100 (where 100 = most favorable nuclear materials security conditions)**
4.1	**UN Security Council Resolution (UNSCR) 1540 Implementation**	**Scored 0–5 (where 5 = most favorable nuclear materials security conditions)**
4.1.1	UNSCR 1540 reporting	Scored 0–1
4.1.2	Extent of UNSCR 1540 implementation	Scored 0–4

4.2	**Domestic Nuclear Security Legislation**	**Scored 0–3 (where 3 = most favorable nuclear materials security conditions)**
4.2.1	CPPNM implementation authority	Scored 0–1
4.2.2	National legal framework for CPPNM	Scored 0–1
4.2.3	Convention on Nuclear Safety report	Scored 0–1
4.3	**Independent Regulatory Agency**	**Scored 0–1 (where 1 = most favorable nuclear materials security conditions)**
4.3.1	Independent regulatory agency	Scored 0–1
5	**RISK ENVIRONMENT**	**Scored 0–100 (where 100 = most favorable nuclear materials security conditions)**
5.1	**Political Stability**	**Scored 0–20 (where 20 = most favorable security conditions)**
5.1.1	Social unrest	Scored 0–4
5.1.2	Orderly transfers of power	Scored 0–4
5.1.3	International disputes or tensions	Scored 0–4
5.1.4	Armed conflict	Scored 0–4
5.1.5	Violent demonstrations or violent civil or labor unrest	Scored 0–4
5.2	**Effective Governance**	**Scored 0–8 (where 8 = most favorable nuclear materials security conditions)**
5.2.1	Effectiveness of the political system	Scored 0–4
5.2.2	Quality of the bureaucracy	Scored 0–4
5.3	**Pervasiveness of Corruption**	**Scored 0–4 (where 4 = most favorable security conditions)**
5.3.1	Pervasiveness of corruption	Scored 0–4
5.4	**Group(s) Interested in Committing Acts of Nuclear Terrorism**	**Scored 0–2 (where 2 = most favorable security conditions)**
5.4.1	Group(s) interested in committing acts of nuclear terrorism	Scored 0–2

Calculation of the 2018 NTI Nuclear Security Index

Modeling the subindicators, indicators, and categories in the NTI Index results in overall scores of 0–100 for each country, in which 100 represents the most favorable and 0 the least favorable nuclear security conditions possible. A score of 100 in the NTI Index does not indicate that a country has perfect nuclear security and a score of 0 does not mean that a country has no security. Instead, scores of 100 and 0 represent the highest or lowest possible scores, respectively, as measured by the NTI Index criteria. The subindicators listed are classified into indicators, and their values are summed to determine the value of the indicator:

indicator score = ∑ individual subindicators

For the theft ranking for countries with materials, the indicators are classified into five categories: Quantities and Sites (3 indicators), Security and Control Measures (6 indicators), Global Norms (3 indicators), Domestic Commitments and Capacity (4 indicators), and Risk Environment (4 indicators). For the theft ranking for countries without materials, the indicators are classified into three categories: Global Norms (2 indicators), Domestic Commitments and Capacity (3 indicators), and Risk Environment (4 indicators). For the sabotage ranking, the indicators are classified into five categories: Number of Sites (1 indicator), Security and Control Measures (5 indicators), Global Norms (3 indicators), Domestic Commitments and Capacity (3 indicators), and Risk Environment (4 indicators). The category values are a weighted total of the indicators in the category:

category score = ∑ weighted individual indicators

The category values have been normalized on the basis of the following equation:

$$x = (x - \text{Min}(x)) / (\text{Max}(x) - \text{Min}(x)),$$

where Min(x) and Max(x) are, respectively, the lowest and highest values in the NTI Index (i.e., out of the 22 countries with materials, out of the 154 countries without materials, or out of the 44 countries and Taiwan with nuclear facilities at risk of sabotage) for any given indicator. The normalized value (i.e., a score of 0–100) makes it directly comparable with other normalized indicator scores.

The following example shows the calculation of a category score:

		Normalized Score (0–100)	Weight	Weighted Score	
1.1	Quantities of Nuclear Materials	100	42	42% of 100	42
1.2	Sites and Transportation	50	35	35% of 50	18
1.3	Material Production/Elimination Trends	100	23	23% of 100	23

The overall score for each country is the weighted sum of the category scores, as determined by the weighting profile:

Overall score = ∑ weighted category scores

The following example shows the calculation of an overall score:

		Normalized Score (0–100)	Weight	Weighted Score	
1	Quantities and Sites	55	16	16% of 55	9
2	Security and Control Measures	38	29	29% of 38	11
3	Global Norms	88	17	17% of 88	15
4	Domestic Commitments and Capacity	44	20	20% of 44	9
5	Risk Environment	58	18	18% of 58	10

The countries with materials, countries without materials, and countries with nuclear facilities at risk of sabotage can then be ranked according to those parameters.

Model Weights

The weights assigned to each category and indicator can be changed in the NTI Nuclear Security Index data models to reflect different assumptions about their relative importance. Three sets of weights are provided in all of the data models. The weights defined by NTI and the EIU are the default setting. They are based on extensive discussions between NTI, the EIU, the International Panel of Experts, and others on the relative value of each category and indicator. The second weighting option, called neutral weights, assumes equal importance of all categories and evenly distributes weights on that basis. The third option, equal weights, assigns an identical weight to each indicator, rather than to each category.

The first option, which is used for the NTI and EIU default weights, uses expert judgment to assign weights to indicators and brings a real-world perspective to an index, which is important if an index is to guide policy actions. The second and third options—in which all categories or indicators, respectively, are weighted equally—have the advantage of simplicity and do not involve subjective judgment. A disadvantage of these options is that they assume that all indicators or categories, respectively, are equally significant.

A fourth weighting option, which is included in the theft ranking for countries with materials and sabotage ranking data models, is principal components analysis (PCA) weights. PCA weights are derived through a mathematical process that takes into account the covariance between indicators and the importance of a particular element in maximizing the variation in the index scores. It aims to minimize redundancy between variables and to maximize the variance within the index, but it does not consider indicators' perceived importance.

Weight Profile Defined by NTI and the EIU for the Theft Ranking for Countries with Materials

CATEGORY	WEIGHT
Quantities & Sites	16%
Security and Control Measures	29%
Global Norms	17%
Domestic Commitments and Capacity	20%
Risk Environment	18%

	INDICATOR	WEIGHT
1	**Quantities and Sites**	
1.1	Quantities of Materials	42%
1.2	Sites and Transportation	35%
1.3	Material Production/Elimination Trends	23%
2	**Security and Control Measures**	
2.1	On-site Physical Protection	20%
2.2	Control and Accounting Procedures	15%
2.3	Insider Threat Prevention	19%
2.4	Physical Security During Transport	18%
2.5	Response Capabilities	18%
2.6	Cybersecurity	10%
3	**Global Norms**	
3.1	International Legal Commitments	42%
3.2	Voluntary Commitments	27%
3.3	International Assurances	31%
4	**Domestic Commitments and Capacity**	
4.1	UN Security Council Resolution (UNSCR) 1540 Implementation	20%
4.2	Domestic Nuclear Materials Security Legislation	31%
4.3	Safeguards Adherence and Compliance	22%
4.4	Independent Regulatory Agency	27%

5	**Risk Environment**	
5.1	Political Stability	26%
5.2	Effective Governance	25%
5.3	Pervasiveness of Corruption	22%
5.4	Group(s) Interested in Illicitly Acquiring Materials	27%

Weight Profile Defined by NTI and the EIU for the Theft Ranking for Countries without Materials

CATEGORY	WEIGHT*
Global Norms	31%
Domestic Commitments and Capacity	38%
Risk Environment	31%

	INDICATOR	WEIGHT
3	**Global Norms**	
3.1	International Legal Commitments	64%
3.2	Voluntary Commitments	36%
4	**Domestic Commitments and Capacity**	
4.1	UN Security Council Resolution (UNSCR) 1540 Implementation	33%
4.2	Domestic Nuclear Materials Security Legislation	41%
4.3	Safeguards Adherence and Compliance	26%
5	**Risk Environment**	
5.1	Political Stability	24%
5.2	Effective Governance	25%
5.3	Pervasiveness of Corruption	26%
5.4	Groups Interested in Illicitly Acquiring Materials	25%

Weight Profile Defined by NTI and the EIU for the Sabotage Ranking

CATEGORY	WEIGHT
Number of Sites	5%
Security and Control Measures	33%
Global Norms	19%
Domestic Commitments and Capacity	23%
Risk Environment	20%

Principal Components Analysis

The goal of principal components analysis (PCA) is to define quantitatively a weighting scheme for the indicators that are used to create a composite index or ranking. PCA is a method for removing redundant information shared across indicators by specifying a weighting that explains the most variance in the data.

The PCA-weights feature within the NTI Index models has been provided for those experts who may wish to explore the behavior of the model in more depth. They should not be considered (a) as an alternative to the NTI/EIU weights or (b) as a means of understanding country rankings and scores, because they do not consider the intrinsic significance of an indicator in the context of the NTI Nuclear Security Index.

PCA assigns each element in an index a weight that takes into account the covariance between indicators and the importance of a particular element in maximizing the variation in the index outcome (nuclear security conditions). In other words, it aims to minimize redundancy between variables and to maximize the variance with respect to the outcome. The weight is calculated by taking the principle component (eigenvector) associated with the highest explained variance (eigenvalue).

This is a way of decomposing the data into independent components ordered by informational content and, according to Ram (1982),[10] is a natural choice for an index weighting. Important assumptions for valid PCA are (a) that variance is meaningful and not the result of data with large measurement error and (b) that the dynamics of interest (nuclear security conditions) are along the direction with the largest variance.

A one-stage PCA analysis solves for the weights that maximize the variance across all of the indicators, irrespective of category membership:

1. Perform PCA analysis on all of the indicators at once, ignoring category membership.
2. Take the principal component associated with the highest eigenvalue.
3. Set negative components to zero (if positive weights are required).
4. Normalize within indicator weights so that the sum of the weights is 1.
5. Normalize the category weights so that the sum across categories is 1.
   - Take the sum of the non-normalized subindicator weights, and use this as the indicator weight for that category.
   - Then renormalize top-level indicator weights across indicators so that those also sum to 1.

Variation within indicator weights is a sign of redundancy in the elements or that some elements are not as relevant in explaining the variation in the overall index once all of the other variables are considered. Finding equal weights across indicators is a sign of very little redundancy across subgroups and similar relevance in explaining variation in the index, which suggests that the index was appropriately divided into subgroups.

Weight Profile Defined by PCA for the Theft Ranking for Countries with Materials

	INDICATOR	WEIGHT
1	**Quantities and Sites**	
1.1	Quantities of Materials	0%
1.2	Sites and Transportation	15%
1.3	Material Production/Elimination Trends	85%
2	**Security and Control Measures**	
2.1	On-site Physical Protection	25%
2.2	Control and Accounting Procedures	14%
2.3	Insider Threat Prevention	16%
2.4	Physical Security During Transport	9%
2.5	Response Capabilities	26%
2.6	Cybersecurity	10%
3	**Global Norms**	
3.1	International Legal Commitments	36%
3.2	Voluntary Commitments	34%
3.3	International Assurances	30%
4	**Domestic Commitments and Capacity**	
4.1	UN Security Council Resolution (UNSCR) 1540 Implementation	28%
4.2	Domestic Nuclear Materials Security Legislation	25%
4.3	Safeguards Adherence and Compliance	27%
4.4	Independent Regulatory Agency	20%
5	**Risk Environment**	
5.1	Political Stability	46%
5.2	Effective Governance	28%
5.3	Pervasiveness of Corruption	25%
5.4	Group(s) Interested in Illicitly Acquiring Materials	1%

[10] Rati Ram, "Composite Indices of Physical Quality of Life, Basic Needs Fulfillment, and Income: A 'Principal Component' Representation," *Journal of Development Economics* 11, no. 2 (October 1982): 227–47.

Weight Profile Defined by PCA for the Sabotage Ranking

	INDICATOR	WEIGHT
1	**Number of Sites**	
1.1	Number of Sites	100%
2	**Security and Control Measures**	
2.1	On-site Physical Protection	31%
2.2	Control and Accounting Procedures	19%
2.3	Insider Threat Prevention	17%
2.4	Response Capabilities	20%
2.5	Cybersecurity	13%
3	**Global Norms**	
3.1	International Legal Commitments	34%
3.2	Voluntary Commitments	33%
3.3	International Assurances	33%
4	**Domestic Commitments and Capacity**	
4.1	UN Security Council Resolution (UNSCR) 1540 Implementation	44%
4.2	Domestic Nuclear Security Legislation	39%
4.3	Independent Regulatory Agency	17%
5	**Risk Environment**	
5.1	Political Stability	45%
5.2	Effective Governance	27%
5.3	Pervasiveness of Corruption	24%
5.4	Group(s) Interested in Committing Acts of Nuclear Terrorism	4%

Model Correlations

Correlating the 2018 theft ranking for countries with materials to other data sets reveals some potentially interesting associations. Correlations measure the strength of a relationship between two variables. Scatter plots, which can be found on the "Correlation-Scatter Plot" worksheet in the theft ranking model for countries with materials, show the correlations between the 2018 ranking and a number of variables. Correlation analysis for three of these variables can be found below:

1. **Global Peace Index.** The 2017 Global Peace Index (GPI) gauges ongoing domestic and international conflict, safety and security in society, and levels of militarization. GPI is scored from 1 to 5, where countries that are most at peace receive a score of 1 and countries with lower levels of peace receive a higher value. In the 2018 theft ranking for countries with materials, the GPI scale is inverted so that countries that are most at peace receive a score of 5 and those that are less peaceful receive lower scores. The results indicate a high positive correlation (0.83) between a country's GPI score and its 2018 theft ranking for countries with materials score. This result has a certain logic because a high GPI score corresponds to a higher level of peace and implies a higher level of nuclear materials security. The correlation is positive because as GPI decreases (meaning a country is less at peace), the 2018 theft ranking for countries with materials decreases (meaning nuclear materials security conditions are less favorable).

2. **Regulatory quality.** The regulatory quality indicator is a qualitative assessment of capturing perceptions of the ability of the government to formulate and implement sound policies and regulations and is taken from the World Bank's Worldwide Governance Indicators (WGI). Countries are ranked from -2.50 to 2.50, where -2.50 is "very low" and 2.50 is "very high." There is a strong positive correlation of 0.81 between the regulatory quality variable and the 2018 theft ranking for countries with materials. The correlation shows that countries with higher regulatory quality tend to have better nuclear materials security conditions.

3. **Gross domestic product (GDP) per head.** This quantitative indicator is a measure of GDP per head in nominal U.S. dollar terms and allows for a basic comparison of countries in terms of standard of living. For countries with weapons-usable nuclear materials, the correlation between GDP per capita and the 2018 theft ranking for countries with materials score is 0.71. The correlation shows that as GDP per capita increases, a country's overall NTI Index score is likely to increase as well.

COMPARISON BETWEEN THE 2016 AND 2018 NTI INDICES

NTI and the EIU made one change to the NTI Index framework for the theft ranking for countries with materials and to the sabotage ranking between 2016 and 2018. The goal of this change was to refine the 2018 framework to capture a country's nuclear materials security conditions more rigorously. A subindicator was added to the cybersecurity indicator to assess the procedures and response capabilities in place at nuclear facilities in the case of a cyber incident, leading to a total of 61 subindicators for the theft ranking for countries with materials, and a total of 52 subindicators for the sabotage ranking. This section provides greater detail about this change as well as about how countries were compared and what methodology was used to facilitate the comparison between the 2016 and 2018 rankings.

New Indicators

The Cybersecurity indicator was added in 2016 to address a critical component of protection against theft or acts of sabotage: the protection of nuclear facilities from a cybersecurity incident or cyberattack. The 2016 indicator included four subindicators, which focused on protection from a cybersecurity incident. Given the growing threat of cyber incidents at nuclear facilities and after subsequent conversations with the International Panel of Experts, a fifth subindicator was added in 2018, both to the theft ranking for countries with materials and to the sabotage ranking. It encompasses response to a cybersecurity incident. Although it is important for a nuclear facility to be able to prevent a cyberattack, it is essential to have a response mechanism if preventive measures fail.

In designing the new subindicator, the EIU investigated different elements of cyber-incident response in countries. During the subindicator review process, the EIU considered not only cyber-incident response plans but also coordination between the cyber-incident response and physical protection and the existence of a computer emergency response team (CERT) with a remit to respond to cyber incidents at nuclear facilities, among others. The need to be able to create an objective assessment of cyber incident response with comparability across countries, along with expert input, led us to incorporate just one question around cyber incident response plans into the 2018 NTI Index.

Here is a description of the new subindicator:

> **2.6.5/2.5.5 Cyber incident response plan**
> This subindicator captures whether nuclear facilities are required to have a cyber incident response plan (i.e., a plan of action to respond to a cybersecurity incident or cyberattack at a nuclear facility). Countries receive credit if domestic laws, regulations, or licensing requirements require such a plan. A plan of action to respond to a cybersecurity incident or cyberattack at nuclear facilities helps to limit damage and reduce recovery times.

Comparability between 2016 and 2018

To ensure an accurate year-on-year comparison, the EIU required identical data sets for 2012, 2014, 2016, and 2018 for the theft ranking for countries with materials and for 2016 and 2018 for the sabotage ranking.[11] The inclusion of the new subindicator described above posed a challenge, because it had not been scored in the 2016, 2014, or 2012 editions of the NTI Index. The EIU undertook research to rescore the 2016, 2014, and 2012 theft rankings for countries with materials and the 2016 sabotage ranking—using the revised 2018 NTI Index framework—as if it were 2015, 2013, and 2011 (when research for the 2016, 2014, and 2012 NTI Indices, respectively, had been conducted).

In some cases, the scores that would have been assigned for 2016, 2014, and 2012 were easily determined by the date of the relevant regulatory document. For example, if a country's regulation describing cyber-incident response plans had been published in 2007, then the researcher would assign the appropriate score for the previous rankings on the basis of that document, because it would have been available when the research was undertaken in 2011, 2013, and 2015. When the EIU could not confirm whether a requirement had been in place during a previous research period, it either queried the relevant government or, when that was not possible, made measured assumptions that were based on whether regulatory changes relevant to nuclear cybersecurity had been instituted in that country in recent years.

[11] No changes were made to the theft ranking for countries without materials between 2016 and 2018.

In addition to rescoring the 2012, 2014, and 2016 data for the new indicator, in a limited number of cases the EIU adjusted previous scores on the basis of new evidence. In all cases, if a previous score was deemed to be inaccurate, the EIU corrected the score to reflect the most up-to-date information available. Those adjustments helped to ensure that no artificial improvements or declines in scores were captured in the 2018 theft ranking for countries with materials or in the 2018 sabotage ranking.

In a few instances, a country's response to the 2018 data review and confirmation request contradicted its 2016 response. In those cases, the EIU first queried the government about the discrepancy. If the EIU did not receive a response to the query, additional research was undertaken, and in some cases, reasonable assumptions were made on the basis of available sources. In some cases, a previous score was adjusted on the basis of (a) the more recent 2018 data review and confirmation responses and (b) the evidence provided by a government.

Once the EIU had comparable data sets across the four iterations of the NTI Index, a year-on-year comparison could highlight where scores had improved, remained the same, or declined on the basis of actions taken by countries. The scores and rankings for the rescored 2012, 2014 and 2016 theft rankings and the 2018 theft rankings, as well as the rescored 2016 sabotage ranking and the 2018 sabotage ranking, were calculated using the same framework, methodology, and weights—as described in *Calculating the 2018 NTI Nuclear Security Index*. Owing to the methodological change and updated scores described above, the normalized scores and ranks in the originally published 2012, 2014, and 2016 models and the 2012, 2014, and 2016 NTI Index reports are not comparable to the normalized scores and ranks in the newly rescored 2012, 2014, and 2016 data or to those in the 2018 models. To understand changes in scores between 2012, 2014, 2016, and 2018 resulting from actions taken by countries, people should use the 2018 models and their comparison tools, rather than the 2012, 2014 and 2016 models.

The 2018 theft ranking models include a new summary of the scores and ranks for the rescored 2012, 2014, and 2016 data. The 2018 sabotage model includes a new summary of the scores and ranks for the rescored 2016 data. The original 2012, 2014, and 2016 NTI Index models have been archived for reference only.

COMPARISON BETWEEN THE THEFT RANKING FOR COUNTRIES WITH MATERIALS AND SABOTAGE RANKING

Given the widespread threat of sabotage and the serious potential consequences of a significant radiological release, NTI and the EIU decided to include an assessment of sabotage in the 2016 NTI Index. Countries were selected for inclusion in the new sabotage ranking if they possessed nuclear facilities that, if sabotaged, could result in a significant radiological release with serious off-site health consequences. The following types of nuclear facilities meet this definition: (a) operating nuclear power reactors or nuclear power reactors that have been shut down within the last five years, (b) research reactors with a capacity of 2MW or greater, (c) reprocessing facilities, and (d) spent fuel pools—if the fuel has been discharged in the last five years and is not associated with an operating reactor. NTI and the EIU identified 44 countries and Taiwan with such facilities. Twenty of the countries in the theft ranking for countries with materials; 24 of the countries, plus Taiwan, in the theft ranking for countries without materials are included in the sabotage ranking.

Although many indicators in the theft ranking framework and the sabotage ranking framework are the same, the sabotage ranking framework specifically addresses the sabotage of nuclear facilities. Several subindicators in the theft ranking are slightly altered in the sabotage ranking to reflect differences in how nuclear facilities are protected against theft versus against sabotage. In such cases, a country's score on the same subindicator in the theft ranking for countries with materials and in the sabotage ranking may differ. Additionally, five sabotage-specific subindicators are included in the sabotage ranking framework, and 14 subindicators that are included in the theft ranking for countries with materials are considered irrelevant to sabotage and are not included in the sabotage ranking framework.[12]

[12] It is important to note that although indicator and subindicator numbers differ between the theft ranking model and the sabotage ranking model, the questions asked and the scoring criteria used often remain consistent. Any inconsistencies are explained in the indicator frameworks at the end of this EIU Methodology appendix.

The chart that follows shows the differences between the theft and sabotage rankings. Those indicators that are grayed out are not included in the sabotage ranking framework; categories, indicators, and subindicators with asterisks have been altered in the sabotage ranking framework; and subindicators in green are those that are included solely within the sabotage ranking.

QUANTITIES AND SITES*
Quantities of Nuclear Materials
Quantities of nuclear materials
Sites and Transportation*
Number of sites*
Bulk processing facility
Frequency of materials transport
Material Production/Elimination Trends
Material production/elimination trends
SECURITY AND CONTROL MEASURES
On-site Physical Protection
Mandatory physical protection
On-site reviews of security
Design Basis Threat (DBT)
Security responsibilities and accountabilities
Performance-based program
Control and Accounting Procedures*
Legal and regulatory basis for MC&A
Measurement methods
Inventory record
Material Balance Area(s)
Radiological consequences (materials)
Radiological consequences (equipment, systems and devices)
Control measures*
Access control
Insider Threat Prevention
Personnel vetting
Frequency of personnel vetting
Reporting
Surveillance*
Physical Security During Transport
Physical security during transport
Response Capabilities
Emergency response capabilities
Armed response capabilities*
Law enforcement response training
Nuclear infrastructure protection plan
Cybersecurity
Mandatory cybersecurity
Critical digital asset protection
Cybersecurity DBT
Cybersecurity assessments
Cyber incident response plan
GLOBAL NORMS
International Legal Commitments
Physical Protection Convention (CPPNM)
2005 Amendment to the CPPNM
Nuclear Terrorism Convention (ICSANT)
Convention on Nuclear Safety
Voluntary Commitments
IAEA membership
PSI membership
Global Initiative (GICNT) membership
Global Partnership membership
WINS contributions
IAEA Nuclear Security Fund contributions
Bilateral/multilateral assistance
Centers of Excellence
International Assurances*
Published regulations/reports
Public declarations/reports about nuclear materials
Review of security arrangements

DOMESTIC COMMITMENTS AND CAPACITY
UNSCR 1540 Implementation
UNSCR 1540 reporting
Extent of UNSCR 1540 implementation*
Domestic Nuclear Security Legislation
CPPNM implementation authority
National legal framework for CPPNM
Convention on Nuclear Safety report
Safeguards Adherence and Compliance
IAEA safeguards agreement (excl. Additional Protocol)
IAEA Additional Protocol
Facility exclusion from safeguards
Safeguards violations
Independent Regulatory Agency
Independent regulatory agency
RISK ENVIRONMENT
Political Stability
Social unrest
Orderly transfers of power
International disputes/tensions
Armed conflict
Violent demonstrations or violent civil/labor unrest
Effective Governance
Effectiveness of the political system
Quality of the bureaucracy
Pervasiveness of Corruption
Pervasiveness of corruption
Group(s) Interested in Committing Acts of Nuclear Terrorism*
Group(s) interested committing acts of nuclear terrorism*

DEVELOPMENTS IN NUCLEAR SECURITY SINCE THE 2016 NTI INDEX

Although changes to the NTI Index framework between 2016 and 2018 were minimal, other developments in global nuclear security commitments and security best practices have been captured in this iteration of the Index. This section provides greater detail about those developments.

1540 Matrix Implementation

The United Nations Security Council Resolution (UNSCR) 1540 Committee, a UN entity established in 2004, evaluates compliance by UN Member States to UNSCR 1540. This resolution obliges countries to refrain from supporting—by any means—non-state actors in developing, acquiring, manufacturing, possessing, transporting, transferring, or using nuclear, chemical, or biological weapons and their delivery systems. The Committee maintains a database of all domestic nuclear security legislation tied to UNSCR 1540 passed by Member States.

As part of the evaluation process, the 1540 Committee created the 1540 Matrix, a document that collates information about a country's implementation of UNSCR 1540 and its subsequent resolutions: 1673 (2006), 1810 (2008), 1977 (2011), and 2325 (2016). The 1540 Matrices do not measure a country's compliance with non-proliferation obligations; rather, they provide the 1540 Committee with a reference tool that may be used to facilitate technical assistance to Member States to help implement UNSCR 1540.

The 1540 matrices collate information from national report submissions to the 1540 Committee and are complemented by additional official government information from the submitting countries. The Group of Experts supports the 1540 Committee's work and prepares the 1540 Matrices on the basis of the information provided. The 1540 Committee, in turn, reviews and approves the matrices. Not all member states submit completed 1540 Matrices. Excluding Taiwan, which is unable to submit a matrix, 26 countries from the NTI Nuclear Security Index did not participate in the process during the previous official 1540 Matrix update in 2009.

In 2015, the 1540 Committee updated the 1540 Matrix template to include three new security-related elements (related to 1540 obligations) that had not been included in the 2009 template: (a) the International Convention for the Suppression of Acts of Nuclear Terrorism (ICSANT), (b) the 2005 Amendment to the CPPNM, and (c) the IAEA's Code of Conduct on the Safety and Security of Radioactive Sources and their supplementary Guidance on the Import and Export of Radioactive Sources.

The 1540 Committee approved 197 country submissions in 2015–16 using this new template. Only one country from the NTI Nuclear Security Index, North Korea, did not participate in the process during the 2015 update.

The NTI Index includes two subindicators that are specifically drawn from the 1540 Matrices: *"UNSCR 1540 reporting"* and *"Extent of UNSCR 1540 implementation."* *"UNSCR 1540 reporting"* asks whether or not a country participates in the 1540 process, while *"Extent of UNSCR 1540 implementation"* looks at the degree to which countries have implemented the elements included in the 1540 matrices. Scoring for this subindicator is based on an evaluation of the total number of elements of UNSCR 1540 that have been implemented, as reflected in individual country matrices. The latter was updated in 2016 to include the refined set of elements as described in the nuclear security note earlier herein. The 1540 reports are one of the few publicly available sources that assess country-level commitments around nuclear security; as such, the 1540 Matrix's subindicators are included both in the theft rankings and the sabotage rankings.

Because the majority of the 1540 matrices had not been updated since 2009, past iterations of the NTI Index had revealed few country-level improvements, given the indicator's reliance on data from those matrices. However, with the 2015 update to the 1540 matrices, the fourth iteration of the NTI Index has captured significant improvements achieved since 2009 in country-level commitments and adherence to global norms.

Outcomes-Based Regulations

Security at nuclear facilities is continuously improving. Historically, countries have focused on prescriptive regulations to ensure that nuclear materials and nuclear facilities are secure against theft and sabotage. However, some governments are working with the operators to design new security approaches that may require the NTI Index to rethink how it assesses scores.

Those countries are moving away from prescriptive regulations in favor of more outcomes- or results-based approaches. Rather than set regulations at the national level that must then be implemented by operators across all facilities, an outcomes-based regulatory approach develops a set of parameters against which facilities must be protected (e.g., cyberattacks or armed attacks) but puts the onus on the licensee or operator to design specific procedures tailored to their facilities to meet the parameters. An outcomes-based approach assigns licensees a greater level of responsibility in shaping and overseeing the regulatory framework for the security of their nuclear facilities. The shift is also designed to promote a more congruent working relationship between the licensee and the regulator.

Advocates of outcomes-based regulation make a number of arguments to support this approach. First, in the absence of regulator-prescribed standards, licensees have to take greater responsibility for the design and implementation of their security arrangements. Second, outcomes-based regulation allows the regulator to be an enabler and fosters an environment of innovation and continuous improvement, where it is within licensees' authority to adopt novel security solutions that work in harmony with their business processes. Third, it gives licensees the flexibility to quickly review and optimize their arrangements in response to dynamic threat environments.

Throughout the course of the research process for the 2018 NTI Index, the EIU encountered a number of countries that are shifting toward an outcomes-based approach to nuclear security, especially in the area of personnel

vetting. For example, many countries are employing "continuous" vetting of personnel. Rather than requiring personnel to pass alcohol or drug tests at fixed intervals, all personnel at facilities are trained to monitor the behavior of their colleagues and to report any anomalies observed. These anomalies then result in a more formalized vetting procedure to identify the cause of aberrant behavior and to determine if the behavior presents risks to the facility.

In cases where countries indicated that they had outcomes-based rather than prescriptive regulations, their scores were adjudicated by the EIU on a case-by-case basis. Because an increasing number of countries have adopted outcomes-based regulations since the NTI Index was first launched in 2012, the EIU expects this area to have a growing effect on the index's methodology and rankings in the future.

RESEARCH BEHIND SELECTED INDICATORS

This section focuses on the research behind selected indicators, and it includes an explanation for the scoring framework behind several of the more complex variables created by the EIU. Scoring criteria for all of the indicators are included in the section entitled Sources and Definitions of Indicators.

Approach

The EIU employed country experts and regional specialists with a wide variety of necessary linguistic skills to undertake the research from its global network of more than 350 analysts and contributors. Researchers were asked to gather data from primary legal texts; government and academic publications; and websites of government authorities, international organizations, and non-governmental organizations. Researchers also contacted government officials and subject-matter specialists and reviewed local and international news and media reports. The EIU research was constrained by a lack of publicly available information in some cases and by a general lack of openness in the area of nuclear security. The research process proved challenging, both because of the difficulty in sourcing data and official information related to nuclear security and, in some cases, because of a lack of publicly available information.

Challenging Indicators

1.1 Quantities of Nuclear Materials (Theft ranking for countries with materials)

This indicator seeks to capture each country's combined total quantity of highly enriched uranium (HEU), separated plutonium, and plutonium content in unirradiated mixed oxide fuel (MOX). Materials that are owned by one country but are present in another are accounted for under the latter's total. Plutonium content in MOX is either reported as such by a country or calculated as 5–8 percent of total MOX quantities. Quantities include materials in weapons components.

The key challenge in researching quantities of weapons-usable nuclear materials is the general lack of publicly available information in this area, particularly for nuclear-armed countries. The majority of countries do not declare all of their nuclear materials (including materials in weapon components). The EIU relied primarily on three sources for data (in addition to consulting national sources, where available): (a) the Institute for Science and International Security, (b) IAEA and its INFCIRC 549 declarations (civilian plutonium, civilian MOX, civilian HEU), and (c) the International Panel on Fissile Materials (IPFM) and its Global Fissile Material Report 2015 (military HEU and plutonium). In many cases, the sources use estimates or ranges of quantities that are based on the latest available information. Where quantities were provided in a range, the EIU used the midpoint of that range (e.g., a range of 5–10 kilograms was reported as 7.5 kilograms).

Owing to the uncertainties associated with quantities, the EIU banded the data into eight groups. Such banding implies that precise figures could not be ascertained and should increase confidence in the accuracy of scores.

1.2 Number of Sites (Theft ranking for countries with materials)

This indicator seeks to capture how many sites (both military and civilian) with one kilogram or more of HEU (including spent fuel), separated plutonium, or unirradiated MOX fuel are present in a country. Significant challenges arose in researching this indicator. Unsurprisingly, many countries do not publish the number or location of their facilities with weapons-usable nuclear materials. There

are sound national security reasons for not publicizing specific information on quantities and sites. However, this lack of transparency meant that the EIU had to estimate the number of sites in each country on the basis of the limited information that was publicly available. Owing to the uncertainty associated with such estimates, the EIU again decided to band the number of sites, thus implying that precise figures could not be ascertained.

2.2.2–2.2.3 Radiological Consequences (Sabotage ranking)

These two subindicators assess whether countries require the use of a graded approach to security for nuclear materials (2.2.2) and for equipment, systems, and devices (2.2.3) that, if sabotaged, could result in severe radiological consequences. The EIU encountered many challenges when scoring this indicator. The challenges centered primarily on the distinction between safety and security. The subindicators in the NTI Index are designed to address security measures at nuclear facilities. Radiological consequences, however, are relevant to both safety and security concerns. The intersection between safety and security made the research challenging, particularly with regard to the protection of nuclear materials. In many cases, the regulations referenced protection that was based on common categories of nuclear materials that are used by the IAEA in the context of designing protection of materials against theft (Category I, Category II, etc.). The categories are not applied by the IAEA in the context of sabotage, although some countries appear to do so. Ultimately, the EIU decided to give credit for those two subindicators only when the regulations specifically mentioned a graded approach to physical protection or increased levels of security for nuclear materials (for 2.2.2) or equipment, systems, and devices (for 2.2.3) that took into account the radiological consequences of potential sabotage.

2.6/2.5 Cybersecurity (Theft ranking for countries with materials and sabotage ranking)

The Cybersecurity indicator encompasses five subindicators that evaluate a country's mandatory cyber-protection, protection of critical digital assets against cyberattacks, cybersecurity design basis threat (DBT), performance-based assessments of cybersecurity at facilities, and cyber-incident response plans. Cybersecurity has only recently become an area of focus, especially in regard to nuclear security, which means that there is very little publicly available information on the topic. Although some countries already address cybersecurity comprehensively in their national regulations and others are working to update their legislation to include cybersecurity, many countries that have weapons-usable nuclear materials or nuclear facilities at risk of sabotage do not yet have regulations that require cybersecurity at nuclear facilities.

NTI and the EIU decided to be strict when assigning credit for the cybersecurity subindicators. For example, some countries included cybersecurity requirements in their protection plans for critical infrastructure in general, but they did not receive credit for the cybersecurity indicators unless the plans specifically mentioned nuclear facilities. As cybersecurity continues to be a priority, more countries will likely incorporate cybersecurity at nuclear facilities into their regulatory regimes.

5.1–5.3 Risk Environment: Political Stability, Effective Governance, and Pervasiveness of Corruption (Theft rankings and sabotage ranking)

The Risk Environment category comprises four indicators, three of which are discussed in this section. The Political Stability, Effective Governance, and Pervasiveness of Corruption indicators are scored based on proprietary information contained in the EIU's Risk Briefing and its Business Environment Rankings, as indicated in the following table:

5	RISK ENVIRONMENT	
5.1	**Political Stability**	**Source**
5.1.1	Social unrest	Economist Intelligence Unit, Risk Briefing
5.1.2	Orderly transfers of power	Economist Intelligence Unit, Risk Briefing
5.1.3	International disputes/ tensions	Economist Intelligence Unit, Risk Briefing
5.1.4	Armed conflict	Economist Intelligence Unit, Risk Briefing
5.1.5	Violent demonstrations or violent civil/labor unrest	Economist Intelligence Unit, Risk Briefing
5.2	**Effective Governance**	
5.2.1	Effectiveness of the political system	Economist Intelligence Unit, Business Environment Ranking
5.2.2	Quality of the bureaucracy	Economist Intelligence Unit, Risk Briefing
5.3	**Pervasiveness of Corruption**	
5.3.1	Pervasiveness of corruption	Economist Intelligence Unit, Risk Briefing

In the Risk Briefing and Business Environment Ranking assessments, which are updated once each quarter, the EIU takes into account present conditions in each country and the EIU's expectations for the future. The EIU forecasts future risk and business environment conditions rather than simply extrapolating present trends into the future. The comparability of the qualitative assessments is made more rigorous by the extensive guidance provided to the EIU's team of 130 country analysts who undertake the research for each indicator. Analysts are able to view the scoring for other countries, which enables consistency across countries, and additional oversight is provided by the EIU's editorial team, which includes risk heads for every region. The EIU also conducts an annual global audit of all the scores. Ultimately, the ratings and scores rely on the expert opinion of the EIU's analysts working in regional teams that have extensive knowledge of events and conditions in both the countries and the region. Those analysts have a wide range of open and closed sources at their disposal, as discussed in the next paragraph.

Risk Briefing Sources: One of the main closed sources for the Risk Briefing is the EIU's extensive network of more than 250 in-country expert contributors, who are based in virtually every country throughout the world. The EIU's contributors analyze recent market developments and forecast political, economic, and business trends in addition to providing detailed, regular information about conditions within a country. The analysts also draw on the existing analytic work already developed at the EIU. The use of open sources is extensive. International open sources include publications from the United Nations, Central Intelligence Agency, International Monetary Fund, World Bank, International Institute for Management Development, International Labor Organization, and Interpol.

Business Environment Ranking Sources: The main sources used for the historical period scores in the Business Environment Ranking include the following: CIA, *World Factbook*; Economist Intelligence Unit, *Country Risk Service*; Freedom House, *Annual Survey of Political Rights and Civil Liberties*; Heritage Foundation, *Index of Economic Freedom*; UN Development Program, *Human Development Report*; World Bank, *World Development Report*, *World Development Indicators*, and *Doing Business*; and World Economic Forum, *Global Competitiveness Report.*

5.4 Groups Interested in Illicitly Acquiring Materials (Theft rankings) and Groups Interested in Committing Acts of Nuclear Terrorism (Sabotage ranking)

This indicator seeks to understand whether any terrorist or criminal groups interested in illicitly acquiring weapons-usable nuclear materials or interested in committing acts of nuclear terrorism more generally are present in a country and capable of carrying out their goals. Details as to the

extent of a group's presence in a given country could not be ascertained. Additionally, owing to the nature of this topic, which has serious national security implications for states, publicly available information is limited.

Nonetheless, the EIU was able to access various databases (e.g., Global Terrorism Database from the National Consortium for the Study of Terrorism and Responses to Terrorism [START] at the University of Maryland) and other secondary sources (e.g., the U.S. Department of State and relevant news reports about terror-related events) to ascertain which terrorist groups or criminal organizations have a stated interest in acquiring nuclear materials or engaging in another form of nuclear terrorism (see the Selected Bibliography for more information). The EIU then undertook research to determine the countries in which those groups have members present or a base of operations.

Once a list of countries with groups present was established, the EIU used a gradient scale that assessed relative capabilities and intent of groups in each country to make a distinction between the following scores:

- A score of 0 means that such groups exist and are thought to have the capabilities* to carry out their goals when acting alone or with the assistance of a capable third party.
- A score of 1 means that such groups exist but are likely incapable of carrying out their aims.
- A score of 2 means that no such groups are known to be present in the country.

* Capabilities are determined by past activities, including attacks and material recovered by security forces.

Challenging Countries

Although each country posed unique research challenges, China, Iran, Israel, North Korea, and Pakistan were particularly complicated to research. China, Iran, and Pakistan make regulations publicly available, but several regulatory areas in those countries remain confidential. Israel does not publicly acknowledge its nuclear program and, therefore, does not publish any regulations about nuclear security. And although there are some historical insights into the internal workings of nuclear facilities and sites in North Korea, those insights are minimal at best. In the interest of ensuring that the NTI Index is as accurate as possible, the EIU provided scores for several indicators across the five countries using proxy scoring and expert input.

The following scoring methods were applied to those five countries to score the theft ranking for countries with materials and the sabotage ranking.

Use of Military Proxy

Iran, Israel, and North Korea were particularly difficult to score for the On-site Physical Protection indicator (2.1). Those countries are distinct among the countries for which the EIU could not find publicly available information in that they rely primarily on military (or, in the case of Israel, civil defense force) protection for nuclear sites. For indicator 2.1, therefore, the EIU used a proxy indicator—military capability or sophistication—to score the countries. This proxy indicator is scored as follows:

- A score of 0 means "very low": no investment in military research and development (R&D). Principal equipment is very old or obsolete.
- A score of 1 means "low": minimal investment in military R&D. A high percentage of equipment is old and unsophisticated.
- A score of 2 means "moderate": investment of a small part of military expenditure in R&D. Principal equipment is a mixture of new and old and is moderately sophisticated.
- A score of 3 means "high": substantial investment in military R&D and in maintenance. Principal equipment is relatively modern and sophisticated and is well maintained.
- A score of 4 means "very high": huge investment in military R&D and armament production projects. Principal equipment is new and highly sophisticated.

The maximum scores the three countries could receive for indicator 2.1 was 4, where 4 represented the most favorable nuclear materials security conditions. The absence of information about nuclear security reduces public and international understanding of the security measures that countries are taking. Therefore, receiving the highest possible score of 5 for indicator 2.1 was not

appropriate for countries that were scored using a proxy. Additionally, because a proxy indicator was used for those countries, they did not receive separate scores for each of the subindicators in 2.1. Instead, they received an overall score for the indicator.

Assumptions Based on Military Control of Materials

For the following subindicators, the scores for Iran, Israel, North Korea, and Pakistan are based on the assumption that the military imposes a strict regime under direct control of the state:

- 2.3.1 Personnel vetting (Israel and North Korea only)
- 2.4.1 Physical security during transport (Iran, Israel, and North Korea only)
- 2.5.1 Emergency response capabilities (Iran, Israel, and North Korea only)
- 2.5.2 Armed response capabilities
- 2.5.3 Law enforcement response training
- 2.6.1 Cybersecurity regulations (Israel only)

The unique approaches used for each country reflect the relative level of regulations available. For example, while Iran makes publicly available regulations around personnel vetting, it does not publish regulations around response capabilities. However, because Iran's state security and intelligence forces are responsible for security at the country's nuclear sites, it can be inferred that internal, non-public regulations mandate the existence of such response capabilities. Similar assumptions are made across the other countries where regulations are not publicly available, and the military imposes a strict regime around nuclear security conditions.

Expert Input Used

Expert input or secondary sources were used to assign scores for the following indicators and subindicators:

- **China:** 2.2.5 Control measures and 2.3.1 Personnel vetting
- **Israel:** 2.3.1 Personnel vetting
- **North Korea:** 2.2 Control and accounting procedures, 2.3.1 Personnel vetting, and 2.4.1 Physical security during transport
- **Pakistan:** 2.3.1 Personnel vetting and 2.3.2 Frequency of personnel vetting

China and Pakistan make most of their nuclear security regulations publicly available, though some areas are ambiguous or remain confidential.[13] In such instances, the EIU has relied on expert input or secondary evidence to provide appropriate scores. For example, while China's and Pakistan's regulations around personnel vetting do not clearly specify the required screening mechanisms (e.g., drug tests, background checks, or mental fitness checks) for personnel, experts on Chinese nuclear policy and from within the Pakistani nuclear community have confirmed that personnel vetting mechanisms are applied across nuclear facilities in both countries.

Israel

Israel posed a unique research challenge because it maintains a policy of opacity in regards to its nuclear program. Israel does not publish any nuclear security–related laws or regulations that could be used in this research. Moreover, the EIU was unable to elicit expert opinion about Israel's nuclear security conditions as it was for the other challenging countries. As already noted, owing to the lack of publicly available information, the EIU used proxies as a scoring technique for some indicators.

The EIU did not use a proxy (military sophistication) or an assumption based on military (or similar body) protection of nuclear sites to score the Control and Accounting Procedures indicator (2.2). Materials control and accounting (MC&A) is typically not in the purview of security personnel who are responsible for protecting nuclear materials. The EIU and its experts acknowledge that it is more than likely that Israel has regulations regarding MC&A. However, there is an unusual lack of transparency regarding nuclear materials in Israel; thus, the EIU erred on the conservative side in its scoring. The burden of proof is on Israel to demonstrate that it has systems in place. The absence of information is not a positive; it is a negative.

[13] Pakistan recently ratified a nuclear security regulation (which is publicly available) and is in the process of ratifying another, suggesting greater efforts for transparency in the country's nuclear security regulations.

In cases where security-related concerns are typically the responsibility of military or other trained personnel, the EIU did use proxies based on Israel's military sophistication. For example, although Israel's cybersecurity regulations are not publicly available, it has a military cyber unit that is within the Israel Defence Forces (IDF) and that defends the country's critical cyber infrastructure. The EIU was able to make a confident assumption that Israel's nuclear facilities are protected against cyberattacks. The EIU, therefore, provided partial credit to Israel on the cybersecurity indicator.

Impact of Proxies on Scores and Ranks

Recognizing the challenges in scoring Iran, Israel, and North Korea in the Security and Control Measures category, the EIU examined the sensitivity of the overall scores and rankings to changes in scores for the Security and Control Measures indicators. The results are telling: if Iran, Israel, and North Korea received the highest possible scores for indicators 2.1 and 2.2 in the theft ranking for countries with materials, each country's category score and ranking would see the following changes:

Security and Control Measures				
	Current Score	Potential Score	Current Rank	Potential Rank
Iran	36	61 (+25)	22	18 (+4)
Israel	55	74 (+18)	18	16 (+2)
North Korea	38	61 (+23)	20	18 (+2)

Nevertheless, each country's overall ranking and score in the theft ranking for countries with materials would see only a minor change:

Overall				
	Current Score	Potential Score	Current Rank	Potential Rank
Iran	37	44 (+7)	21	20 (+1)
Israel	58	63 (+5)	18	18 (no change)
North Korea	24	31 (+7)	22	22 (no change)

Impact of the Joint Comprehensive Plan of Action (JCPOA) on Iran's Scores

The JCPOA is a 2015 agreement between Iran and the P5+1 (China, France, Germany, Russia, the United Kingdom, and the United States—albeit the latter has since withdrawn from the agreement) that is designed to ensure the peaceful nature of Iran's nuclear program. Specifically, the agreement requires Iran to eliminate or reduce its stockpiles of enriched uranium and gas centrifuges and to refrain from building new heavy-water facilities, over a period of time. Additionally, the agreement permits the IAEA to have access to all Iranian nuclear facilities. In return, Iran was granted nuclear-related economic sanctions relief. Essentially, the goal of the agreement is to avoid Iranian nuclear proliferation risks.

The signing of the JCPOA has had an impact on some of Iran's scores in the NTI Nuclear Security Index. For example, Iran was given full credit (a score of 2) for subindicator 4.3.4 on safeguards violations. Given the country's adherence to the JCPOA, it was assessed that previously reported (to the IAEA Board of Governors or the UN Security Council) that violations of safeguards no longer remain outstanding.

However, Iran's score for subindicator 3.3.3 on review of security arrangements did not change, despite the IAEA having access to the country's nuclear facilities. This subindicator assesses whether a country has hosted security reviews as a way to demonstrate the importance it places on its security obligations. The security reviews include International Physical Protection Advisory Service (IPPAS) missions, International Nuclear Security Advisory Service (INSServ) missions, State System for Accountancy and Control (SSAC) Advisory Service missions, or Integrated Regulatory Review Service (IRRS) missions. However, the JCPOA was not designed to address security obligations (rather, it was designed to address nuclear non-proliferation). Therefore, it does not affect Iran's score for subindicator 3.3.3. The latest IPPAS and IRRS missions to Iran occurred in 2003–2004 and 2010, respectively.

Treatment of Taiwan in the NTI Index

Taiwan is included in the theft ranking for countries without nuclear materials and the sabotage ranking. Taiwan posed a unique research challenge, as it is not currently a member of the IAEA or a party to most international

conventions owing to its status in the international community. However, it has well-established and publicly available regulations. Therefore, for the Security and Control Measures category the EIU reviewed Taiwan's publicly-available nuclear regulations and Atomic Energy Council (AEC) legislation. The EIU also determined that for select indicators it was appropriate to score Taiwan based on relevant domestic regulations and other considerations, as detailed below:

3.1.1 Convention on the Physical Protection of Nuclear Material (CPPNM)

Taiwan is not a party to the CPPNM. The EIU assigned credit to Taiwan based on provisions in its domestic regulations.

3.1.2 2005 Amendment to the CPPNM

Taiwan is not party to the 2005 Amendment to the CPPNM. The EIU has given Taiwan credit on this subindicator based on its domestic regulations and the U.S.–Taiwan 123 Agreement for Peaceful Cooperation, which legally binds Taiwan to follow the CPPNM and the 2005 Amendment. The U.S.—Taiwan 123 Agreement came into force on June 22nd, 2014. Therefore, Taiwan receives credit for the 2005 CPPNM Amendment in the 2016 and 2018 NTI Index, but not in the 2012 or 2014 editions, as there is no evidence that the provisions of the 2005 CPPNM Amendment were legally binding before the 123 Agreement.

3.1.4 Convention on Nuclear Safety

Although Taiwan is not a member to the Convention on Nuclear Safety (CNS), it does regularly submit a Convention on Nuclear Safety report that outlines its commitment to CNS recommendations. The EIU has given Taiwan partial credit (a score of 1) on this subindicator, reflecting its most recent report from 2016.

3.2.1 International Atomic Energy Agency (IAEA) membership

Taiwan is not currently a member of the IAEA. The EIU has scored Taiwan a 1 (full credit) on this subindicator based on its previous membership status.

4.1.1 UN Security Council Resolution (UNSCR) 1540 Reporting

Because Taiwan is not a member of the United Nations, it is not obliged to—and in fact cannot—provide a UNSCR 1540 Report to the 1540 Committee. Despite this, the EIU assigned credit to Taiwan for a report it has drafted and distributed, modeled on 1540 reports, which is publicly available on the AEC's website.

4.1.2 Extent of UNSCR 1540 Implementation

Although Taiwan cannot submit a 1540 matrix to the 1540 Committee, Taiwan has created a 1540 matrix modeled on published 1540 matrices, and it is publicly available on the AEC's website. Treating Taiwan's matrix like other countries' matrices, the EIU has assigned credit based on the number of elements of UNSCR 1540 that have been implemented as reflected in the matrix.

4.2.1 CPPNM implementation authority

The EIU assigned credit to Taiwan on the basis of its having a national authority for the implementation of nuclear security regulations.

4.2.2 National legal framework for CPPNM

The EIU assigned credit to Taiwan on the basis of provisions in its domestic regulations.

4.2.3 Convention on Nuclear Safety report

Although Taiwan is not a member to the Convention on Nuclear Safety (CNS), it does regularly submit a Convention on Nuclear Safety report that outlines its commitment to CNS recommendations. The EIU assigned credit to Taiwan on this subindicator reflecting its most recent report from 2016.

SOURCES AND DEFINITIONS OF INDICATORS

Countries with Weapons-Grade-Usable Materials

Quantities and Sites

This category comprises three indicators: Quantities of Nuclear Materials, Sites and Transportation, and Material Production and Elimination Trends. The category captures the quantity of nuclear materials, the number of sites, and the frequency of transport in a particular country, all related to the risk that materials could be stolen. In addition, it includes a leading indicator as to whether the country is increasing or decreasing its overall material quantities.

Indicator or Subindicator	Source	Indicator Definitions and Construction
1.1 Quantities of Nuclear Materials		**The larger the quantity of nuclear material held, the greater the materials management requirements and potential risk that materials could be stolen.**
1.1.1 Quantities of nuclear materials	Institute for Science and International Security; James Martin Center for Nonproliferation Studies; IAEA INFCIRC 549 declarations; International Panel on Fissile Materials, *Global Fissile Material Report 2017.*	What is the country's combined total quantity of highly enriched uranium (HEU); separated plutonium (Pu); and unirradiated mixed oxide fuel (MOX)? 0 = 500 tonnes or greater 1 = 100–499 tonnes 2 = 10–99.99 tonnes 3 = 2–9.99 tonnes 4 = 500 kg–1.99 tonnes 5 = 100–499 kg 6 = 21–99 kg 7 = 5–20 kg 8 = Less than 5 kg Totals are reported in kilograms and tonnes. 1 tonne = 1,000 kg. Total HEU quantities include spent fuel. Materials owned by one state but that are present in another state are accounted for under the latter's total. Plutonium content in MOX is either reported as such by a state or is calculated as 5–8% of total MOX quantities. Analysis also includes materials in weapon components.

Indicator or Subindicator	Source	Indicator Definitions and Construction
1.2 Sites and Transportation		**The greater the number of sites with nuclear materials and the frequency of transport of those materials, the greater the potential risk of security breaches.**
1.2.1 Number of sites	EIU analyst qualitative assessment	The greater the number of sites with nuclear materials, the greater the potential risk of security breaches. How many sites (both military and civilian) with one kilogram or greater quantities of HEU (including spent fuel), separated plutonium, or unirradiated mixed oxide fuel (MOX) does the country maintain? 0 = 100 sites or greater 1 = 11–99 sites 2 = 2–10 sites 3 = One site A site is defined as a military or civilian location that maintains HEU (including spent fuel); separated Pu; and/or unirradiated MOX material quantities that are equal to or greater than one kilogram. A military base with such nuclear material(s) (including quantities contained in nuclear weapons) is counted as a single site, even if material(s) within the site are contained in two or more buildings. Likewise, a civilian location that maintains materials, either in storage or in use, within multiple buildings is counted as a single site. Military ships that contain nuclear material(s) are counted as a single site. The following types of sites are considered, but are counted only if they contain one kilogram or greater quantities of HEU, separated Pu, or unirradiated MOX: • Dismantlement • Enrichment • Fuel Fabrication • Medical Isotope Production • Plutonium Production Reactor • Power Reactor • Reprocessing • Research and Development • Research Reactors • Storage • Testing • Waste Management
1.2.2 Bulk processing facility	EIU analyst qualitative assessment	Production of nuclear materials in bulk increases the potential for undetected gradual theft of small quantities. Does the country have at least one bulk processing facility handling HEU, separated plutonium, or unirradiated mixed oxide fuel (MOX)? 0 = Yes 1 = No Bulk processing facilities include enrichment, reprocessing, and national fuel cycle facilities.

Indicator or Subindicator	Source	Indicator Definitions and Construction
1.2.3 Frequency of materials transport	EIU analyst qualitative assessment	Because nuclear material is particularly vulnerable during transport, the lower the frequency of transfer of material, the lower the potential risk of security breaches. Are nuclear materials (HEU, separated plutonium, or unirradiated MOX) transported either domestically or internationally? 0 = Yes, transported domestically or internationally, and the country is one of nine nuclear-armed states 1 = Yes, domestically or internationally 2 = No *or* only for removal
1.3 Material Production and Elimination Trends		**Increasing or decreasing the quantities of nuclear material in a state changes the potential risk of materials being stolen.**
1.3.1 Material production and elimination trends	EIU analyst qualitative assessment	Countries receive the following scores based on trends in their total stock of nuclear materials: 0 = The total stock of nuclear materials is increasing 3 = The total stock of nuclear materials remains unchanged 4 = The total stock of nuclear materials is decreasing Scores are based on the actions of a state within the past four years. When considering whether a country's total stock of nuclear materials is decreasing, analysts evaluated the following: • Is the country reducing its stock of nuclear weapons? • Is reprocessing being discontinued? • Are HEU-fueled research reactors being converted to low-enriched uranium (LEU), and are unneeded research reactors being decommissioned? • Are military vessels that are fueled by HEU being converted to LEU? • Is the country returning or giving nuclear materials to another country? • Is a change the result of normal fluctuations due to the use of MOX fuel in power reactors?

Security and Control Measures

The Security and Control Measures category encompasses the core activities directly related to protection and accounting of nuclear materials. This category comprises six indicators: (a) On-site Physical Protection, (b) Control and Accounting Procedures, (c) Insider Threat Prevention, (d) Physical Security during Transport, (e) Response Capabilities, and (f) Cybersecurity.

Indicator or Subindicator	Source	Indicator Definitions and Construction
2.1 On-Site Physical Protection		**Essential measures for securing sites and facilities.**
2.1.1 Mandatory physical protection	EIU analyst qualitative assessment based on official national sources, which vary by country	Requiring licensees to provide physical protection increases the likelihood that nuclear materials facilities will meet strict standards. Is physical protection a condition for licensing? 0 = No *or* information not publicly available 1 = Yes
2.1.2 On-site reviews of security	EIU analyst qualitative assessment based on official national sources, which vary by country	On-site reviews of security increase the likelihood that physical protection measures meet prescribed standards and will be maintained. Are on-site reviews of security done in order to keep a license? 0 = No *or* information not publicly available 1 = Yes
2.1.3 Design Basis Threat (DBT)	EIU analyst qualitative assessment based on official national sources, which vary by country	A Design Basis Threat that is based on strong assumptions and that is regularly updated leads to a more rigorous security system. Do the country's regulations require the use of a Design Basis Threat that is required to be updated? 0 = No *or* information not publicly available 1 = Yes A Design Basis Threat means the attributes and characteristics of potential insider or external adversaries who might attempt unauthorized removal of nuclear material or sabotage against which a physical protection system is designed and evaluated.
2.1.4 Security responsibilities and accountabilities	EIU analyst qualitative assessment based on official national sources, which vary by country	Requiring licensees to hold particular individuals accountable for security increases the likelihood that physical protection measures will be implemented. Does the nuclear regulator define nuclear materials security responsibilities and accountabilities? 0 = No *or* information not publicly available 1 = Yes This subindicator seeks to answer whether the regulator requires licensees to define who is responsible and/or accountable for at least one aspect of nuclear materials security. It is not enough to note that the responsibility for materials security will fall to the licensee. The regulator should require that the licensee have individuals with security responsibilities or accountabilities in at least one area of security.

Indicator or Subindicator	Source	Indicator Definitions and Construction
2.1.5 Performance-based program	EIU analyst qualitative assessment based on official national sources, which vary by country	Required demonstration of performance, along with tests and assessments, improves effectiveness of and identifies weaknesses in physical protection measures. Does the regulator require a performance-based program, which includes tests and assessments of security systems and measures, and a demonstration of performance by security personnel at nuclear sites? 0 = No *or* information not publicly available 1 = Yes
2.2 Control and Accounting Procedures		**Materials control and accounting is a necessary element of a comprehensive security system.**
2.2.1 Legal and regulatory basis for material control and accounting (MC&A)	EIU analyst qualitative assessment based on official national sources, which vary by country	A legal and regulatory basis for materials control and accounting is part of the foundation of a strong system and culture of materials security. Is there a domestic legal and regulatory basis for nuclear material control and accounting (MC&A)? 0 = There is no domestic legal or regulatory basis for MC&A or information not publicly available 1 = There is a legal and regulatory basis for MC&A 2 = There is a legal and regulatory basis for MC&A and international guidelines are reflected in the legal and regulatory system
2.2.2 Measurement methods	EIU analyst qualitative assessment based on official national sources, which vary by country	The quality of measurement methods corresponds to the ability to detect the diversion or theft of nuclear materials. Do domestic regulations or license conditions require measurement methods that provide for accurate and precise quantification of nuclear materials? 0 = No *or* information not publicly available 1 = Yes
2.2.3 Inventory record	EIU analyst qualitative assessment based on official national sources, which vary by country	Maintaining complete, accurate, and timely records of the nuclear material inventory is necessary to detect the diversion or theft of nuclear materials. Do domestic regulations or license conditions require a complete, accurate, and timely record of the nuclear materials inventory that is reported at defined intervals? 0 = No *or* information not publicly available 1 = Yes

Indicator or Subindicator	Source	Indicator Definitions and Construction
2.2.4 Material Balance Area(s)	EIU analyst qualitative assessment based on official national sources, which vary by country	Well-defined and well-controlled geographical locations for nuclear materials enable more accurate accounting and increase the likelihood of detection of diversion or theft of nuclear materials. Do domestic regulations or license conditions require that nuclear materials should be in well-defined and controlled geographical locations within the state? 0 = No *or* information not publicly available 1 = Yes The state body should establish the factors to be taken into account and the criteria to be met in determining material balance area(s) for each nuclear facility. Those areas are established for material accounting purposes, so that (1) the quantity of nuclear material in each transfer into or out of each material balance area can be determined; and (2) the physical inventory of nuclear material in each material balance area can be determined when necessary in accordance with specified procedures. The factors to be taken into account should include: a. the existence and location of key measurement points and b. the use of containment and surveillance measures. The state body should also approve the facility material balance area(s).
2.2.5 Control measures	EIU analyst qualitative assessment based on official national sources, which vary by country	Nuclear materials control measures aid in the assurance that unauthorized access to restricted areas is detected in a timely manner. Do domestic regulations or licensing conditions require the following nuclear materials control measures? a. The identity of persons entering the protected area must be verified. b. Records must be kept of all persons who access inner areas and of all persons who have access to or possession of keys, keycards, and other systems—including computer systems—that control access to inner areas. 0 = Regulations do not require control measures, *or* information not publicly available 1 = Regulations require one of these control measures 2 = Regulations require two of these control measures

Indicator or Subindicator	Source	Indicator Definitions and Construction
2.3 Insider Threat Prevention		**The qualifications of personnel, the strength of the security culture, and the use of certain surveillance measures are critical to how well security procedures are followed and decrease vulnerability to insider threats.**
2.3.1 Personnel vetting	EIU analyst qualitative assessment based on official national sources, which vary by country	Clear guidelines for the qualification and fitness of personnel increases the likelihood that security and other personnel with access to nuclear material areas will effectively discharge their responsibilities and decreases vulnerability to insider threats. Do domestic regulations or license conditions specify that security and other personnel with access to nuclear material areas are subject to the following checks: drug testing; background checks; and psychological or mental fitness checks? 0 = Personnel are not subject to any of these checks 1 = Personnel are subject to one of these checks 2 = Personnel are subject to two of these checks 3 = Personnel are subject to all three of these checks
2.3.2 Frequency of personnel vetting	EIU analyst qualitative assessment based on official national sources, which vary by country	Personnel vetting at frequent intervals is essential to identifying new and changing insider threats. Do domestic regulations or licensing conditions specify that security and other personnel with access to nuclear material areas are vetted at specified intervals? 0 = Frequency of vetting is not specified or information not publicly available 1 = Such personnel are subject to vetting at periods greater than five (5) years 2 = Such personnel are subject to vetting at periods greater than two (2), but not more than five (5) years 3= Such personnel are subject to vetting at periods of two (2) years or less
2.3.3 Reporting	EIU analyst qualitative assessment based on official national sources, which vary by country	Requiring personnel to report suspicious behavior increases the likelihood that insider threats will be detected early. Do domestic regulations or licensing conditions specify that personnel must report suspicious behavior to an official authority? 0 = No *or* information not publicly available 1 = Yes

Indicator or Subindicator	Source	Indicator Definitions and Construction
2.3.4 Surveillance	EIU analyst qualitative assessment based on official national sources, which vary by country	To counter the insider threat, whenever an inner area is occupied, constant surveillance (e.g., a two-person surveillance system or technological surveillance system) should be used to achieve detection of unauthorized action. Do domestic regulations or license conditions require constant surveillance of inner areas when they are occupied, using either a two-person surveillance system or a technological surveillance system? 0 = No *or* information not publicly available 1 = Yes, a two-person surveillance system or a technological surveillance system is required 2 = Yes, both a two-person surveillance system and a technological surveillance system are required *Two-person surveillance system:* Requires at least two knowledgeable persons to be present to verify that activities involving nuclear material and nuclear facilities are authorized, allowing detection of access or actions that are unauthorized. *Technological surveillance:* Technological surveillance includes devices such as closed-circuit television (CCTV) and audio surveillance equipment.
2.4 Physical Security during Transport		**Materials in transit are particularly vulnerable to theft.**
2.4.1 Physical security during transport	EIU analyst qualitative assessment based on official national sources, which vary by country	Are the International Atomic Energy Agency (IAEA) guidelines regarding transport of nuclear materials encompassed in INFCIRC 225, Rev. 4 or Rev. 5 translated into the national regulatory regime? 0 = No *or* information not publicly available 1 = Appropriate guidelines encompassed in INFCIRC 225, Rev. 4 (based on quantities of materials in country) are met 2 = Appropriate guidelines encompassed in INFCIRC 225, Rev. 5 (based on quantities of materials in country) are met

Indicator or Subindicator	Source	Indicator Definitions and Construction
2.5 Response Capabilities		**Response capabilities are part of a layered security system and may enable materials to be recovered should they be stolen from a site.**
2.5.1 Emergency response capabilities	EIU analyst qualitative assessment based on official national sources, which vary by country	Requiring on-site emergency response capabilities, including trained response teams and required incident reports (i.e., notification), increases the level of preparedness for potential nuclear theft incidents. Do the state's licensing requirements for civilian nuclear facilities require that each facility have on-site nuclear security emergency response capabilities? 0 = Licensing does not require an on-site trained response team or incident reports to appropriate law enforcement authority 1 = Licensing requires incident reports to appropriate law enforcement authority 2 = Licensing requires an on-site trained response team 3 = Licensing requires *both* an on-site trained response team and incident reports to appropriate law enforcement authority Capabilities should include a trained response team and a requirement to report an incident to appropriate law enforcement authorities.
2.5.2 Armed response capabilities	EIU analyst qualitative assessment based on official national sources, which vary by country	Requiring on-site armed response capabilities increases the chance of success in responding to armed attacks. Do the state's licensing requirements for civilian nuclear facilities require that each facility with Category I quantities of nuclear material have an on-site armed response team? 0 = No *or* information not publicly available 1 = Yes, on-site armed response team is required *or* state does not have Category I quantities of nuclear material The IAEA classifies 2kg or more of plutonium and 5kg or more of highly enriched uranium (HEU) as Category I materials, and less than 2kg but more than 500g of plutonium and less than 5kg but more than 1kg of HEU as Category II materials. This categorization enables the IAEA to use a graded approach in recommending physical protection measures.
2.5.3 Law enforcement response training	EIU analyst qualitative assessment based on official national sources, which vary by country	Law enforcement officers who are trained to respond to security incidents at nuclear facilities have a greater chance of success responding to those incidents than those who are untrained. Are law enforcement trained to respond in the event of a security incident at a nuclear facility? 0 = No 1 = Yes

Indicator or Subindicator	Source	Indicator Definitions and Construction
2.5.4 Nuclear infrastructure protection plan	EIU analyst qualitative assessment based on official national sources, which vary by country	Natural disasters may increase vulnerability of nuclear materials as a result of physical damage to facilities and additional pressures placed upon government and personnel. Does the country's regulatory framework state that, in the event of a natural disaster, plans are in place to physically protect the nuclear infrastructure? 0 = No mention 1 = Partially mentioned 2 = Fully described Emergency preparedness regulations must mention nuclear facilities specifically.
2.6 Cybersecurity		**Nuclear materials and facilities are vulnerable to cyber attacks as well as physical attacks. Therefore, cybersecurity is a critical component of protecting against theft.**
2.6.1 Mandatory cybersecurity	EIU analyst qualitative assessment based on official national sources, which vary by country	Requiring nuclear facilities to have protection from a cyber attack increases the likelihood that nuclear facilities will take measures to protect against cyber attacks. Do domestic laws, regulations, or licensing requirements require nuclear facilities to have protection from a cyber attack? 0 = No *or* information not publicly available 1 = Yes
2.6.2 Critical digital asset protection	EIU analyst qualitative assessment based on official national sources, which vary by country	Requiring protection of critical digital assets against cyber attacks decreases the chance that an attacker can circumvent physical protection, control and accounting, and safety systems. Do domestic laws, regulations, or licensing requirements require nuclear facilities to protect critical digital assets from a cyber attack? 0 = No *or* information not publicly available 1 = Yes Critical digital assets include the following systems and networks: • Safety-related functions • Security functions • Emergency preparedness functions • Support systems and equipment related to the above functions.
2.6.3 Cybersecurity DBT	EIU analyst qualitative assessment based on official national sources, which vary by country	Requiring that the Design Basis Threat take into account the potential for cyber attacks increases the likelihood that nuclear facilities will consider cyber attacks when designing their security plans. Does the state consider cyber threats in its threat assessment or Design Basis Threat for nuclear facilities? 0 = No *or* information not publicly available 1 = Yes

Indicator or Subindicator	Source	Indicator Definitions and Construction
2.6.4 Cybersecurity assessments	EIU analyst qualitative assessment based on official national sources, which vary by country	Required demonstration of performance, along with tests and assessments, improves effectiveness of and identifies weaknesses in cybersecurity measures. Does the regulator require a performance-based program, which includes tests and assessments of cybersecurity at nuclear facilities? 0 = No *or* information not publicly available 1 = Yes
2.6.5 Cyber incident response plan	EIU analyst qualitative assessment based on official national sources, which vary by country	Requiring an incident response plan (a plan of action to respond) for a cyber security incident or cyber attack at nuclear facilities helps to contain the impact and reduce recovery times. Do domestic laws, regulations, or licensing requirements require a cyber-incident response plan for nuclear facilities? 0 = No *or* information not publicly available 1 = Yes

Global Norms

The Global Norms category includes actions that contribute to the establishment of global norms for nuclear materials security. This category comprises three indicators: (a) International Legal Commitments, (b) Voluntary Commitments, and (c) International Assurances.

Indicator or Subindicator	Source	Indicator Definitions and Construction
3.1 International Legal Commitments*		**International legal commitments are the basis for domestic legislation, regulations, and security capacity.**
3.1.1 Convention on the Physical Protection of Nuclear Material (CPPNM)*	International Atomic Energy Agency (IAEA)	Parties to the CPPNM commit to provide certain levels of physical protection during international transport of nuclear materials; cooperate in the protection, recovery, and return of stolen nuclear material; and criminalize offenses involving nuclear material. Is the state a party to the CPPNM? 0 = Non-compliant or not a member 1 = Signed 2 = Signed and ratified (or action having the same legal effect)
3.1.2 2005 Amendment to the CPPNM*	IAEA	Parties to the 2005 Amendment to the CPPNM commit to expand the scope of their responsibilities under the CPPNM to include protection of nuclear material in domestic use, in storage, and during transport, as well as protection of nuclear facilities. Is the state a party to the 2005 Amendment to the CPPNM? 0 = Not ratified, accepted, or approved 1 = Ratified, accepted, or approved (or action having the same legal effect)

*Denotes that the indicator or subindicator was scored for both countries with weapons-usable nuclear materials and countries without.

Indicator or Subindicator	Source	Indicator Definitions and Construction
3.1.3 International Convention for the Suppression of Acts of Nuclear Terrorism (ICSANT)*	United Nations	Parties to the ICSANT commit to criminalize acts of nuclear terrorism and promote cooperation with other states to prevent, investigate, and punish those acts. Is the state a party to the International Convention for the Suppression of Acts of Nuclear Terrorism (ICSANT)? 0 = Non-compliant *or* not a member 1 = Signed 2 = Signed and ratified (or action having the same legal effect)
3.2 Voluntary Commitments*		**Voluntary commitments demonstrate a state's support for nuclear materials security as a global agenda.**
3.2.1 International Atomic Energy Agency (IAEA) membership*	IAEA	Is the country a member of the IAEA? 0 = No 1 = Yes
3.2.2 Proliferation Security Initiative (PSI) membership*	U.S. Department of State	Is the country a member of the PSI? 0 = No 1 = Yes
3.2.3 Global Initiative to Combat Nuclear Terrorism (GICNT) membership*	U.S. Department of State	Is the country a member of GICNT? 0 = No 1 = Yes
3.2.4 Global Partnership Against the Spread of Weapons and Materials of Mass Destruction membership*	U.S. Department of State	Is the country a member of the Global Partnership Against the Spread of Weapons and Materials of Mass Destruction? 0 = No 1 = Yes
3.2.5 World Institute for Nuclear Security (WINS) contributions*	World Institute for Nuclear Security Annual Report 2016, 2017 and 2018	Has the country provided financial or in-kind contributions to WINS within the previous two years? 0 = No 1 = Yes
3.2.6 IAEA Nuclear Security Fund contributions*	IAEA	Has the country provided financial or in-kind contributions to the IAEA Nuclear Security Fund within the previous two years? 0 = No 1 = Yes
3.2.7 Bilateral/multilateral assistance*	EIU analyst qualitative assessment	Has the country provided financial and/or practical bilateral or multilateral assistance for other states or received such assistance in the field of nuclear security (exclusive of contributions captured elsewhere in this indicator) within the previous two years? 0 = No 1 = Yes

*Denotes that the indicator or subindicator was scored for both countries with weapons-usable nuclear materials and countries without.

Indicator or Subindicator	Source	Indicator Definitions and Construction
3.2.8 Centers of Excellence*	EIU analyst qualitative assessment	Does the country have a Center of Excellence or Nuclear Security Training and Support Center that offers training in nuclear security? 0 = No 1 = Yes To receive credit, a Center of Excellence or Nuclear Security Training and Support Center should have the following characteristics: (a) serve as a centralized organization to facilitate broad cross-industry engagement in education and training; (b) focus on nuclear security, even if safeguards, safety or nuclear energy are also addressed; (c) provide practical training courses; (d) provide education in the form of lectures or seminars; and (e) have government support. Centers that are not yet operational are excluded.
3.3 International Assurances		**International assurances enhance international confidence in the effectiveness of a country's nuclear security conditions.**
3.3.1 Published regulations and reports	EIU analyst qualitative assessment based on official national sources, which vary by country	Public release of broad outlines of nuclear security regulations and nuclear security issues increases confidence in a country's commitment to nuclear material security. Does the state publicly release broad outlines of its nuclear security regulations and/or annual reports on nuclear security issues? 0 = The state does not publish regulations or annual reports 1 = The state publishes regulations or an annual report 2 = The state publishes regulations and an annual report
3.3.2 Public declarations and reports about nuclear materials	EIU analyst qualitative assessment	Public declarations or reports about nuclear material help build international confidence. Does the state make any public declarations or reports about nuclear materials (civilian or military)? 0 = No 1 = Yes A state receives a "yes" if it has made civilian plutonium declarations, if it has made any quantitative declarations about inventories of fissile materials or nuclear weapons, or if it publishes the IAEA's safeguards conclusions for the state.

* Denotes that the indicator or subindicator was scored for both countries with weapons-usable nuclear materials and countries without.

Indicator or Subindicator	Source	Indicator Definitions and Construction
3.3.3 Review of security arrangements	EIU analyst qualitative assessment	Hosting security reviews demonstrates the importance a country places on its security obligations and creates international confidence in levels of security. Has the state hosted a review of its security arrangements? 0 = No 1 = Yes 2 = Yes, within the past five years A state receives credit if it has hosted any of the following IAEA missions, including follow-up missions: International Physical Protection Advisory Service (IPPAS) mission; International Nuclear Security Advisory Service (INSServ) mission; State System for Accountancy and Control (SSAC) Advisory Service; or Integrated Regulatory Review Service (IRRS) missions that have a security component. A state receives a "yes" if it has received bilateral or multilateral assistance (outside an international organization) to review security arrangements.

*Denotes that the indicator or subindicator was scored for both countries with weapons-usable nuclear materials and countries without.

Domestic Commitments and Capacity

This category comprises four indicators: (a) UN Security Council Resolution (UNSCR) 1540 Implementation, (b) Domestic Nuclear Materials Security Legislation, (c) Safeguards Adherence and Compliance, and (d) Independent Regulatory Agency. The category includes actions that indicate how well a country has implemented its international commitments and a country's capacity to do so.

Indicator or Subindicator	Source	Indicator Definitions and Construction
4.1 UN Security Council Resolution (UNSCR) 1540 Implementation*		**UNSCR 1540 obliges action on nuclear materials security and its implementation demonstrates a state's commitment level.**
4.1.1 UNSCR 1540 reporting*	Security Council Committee established pursuant to resolution 1540 (1540 Committee)	Compliance with UNSCR 1540 reporting requirements demonstrates commitment to UNSCR 1540's security objectives. Has the state provided the required UNSCR 1540 report to the Security Council Committee established pursuant to resolution 1540 (1540 Committee)? 0 = The state has not provided a UNSCR 1540 report 1 = The state has provided a UNSCR 1540 report

* Denotes that the indicator or subindicator was scored for both countries with weapons-usable nuclear materials and countries without.

Indicator or Subindicator	Source	Indicator Definitions and Construction
4.1.2 Extent of UNSCR 1540 implementation°	Creation of a coding and scoring scheme by the Economist Intelligence Unit (EIU), based on documents from the 1540 Committee	Implementation of UNSCR 1540 demonstrates commitment to UNSCR 1540's security objectives and improves security procedures and culture. Extent of implementation is identified through the measures taken by a state and reflected in its UNSCR 1540 matrix. Scoring is based on an evaluation of the total number of elements of UNSCR 1540 that have been implemented, as reflected in the individual country matrices. Elements related to nuclear security in the matrix that have been implemented are indicated by an "X." The EIU summed the number of elements related to nuclear security (out of a maximum of 117) with an "X" designation, providing a numerical score for implementation. The resulting numerical score is banded into five categories scored from 0 to 4 points: 0 = Very weak (0–24 points) 1 = Weak (25–49 points) or matrix exists but is not publicly available 2 = Moderate (50–74 points) 3 = Good (75–99 points) 4 = Very good (100+ points) For countries without weapons-usable nuclear materials, 87 elements in the matrix were evaluated, and the following scoring scheme was used: 0 = Very weak (0–14 points) 1 = Weak (15–29 points) or matrix exists but is not publicly available 2 = Moderate (30–44 points) 3 = Good (45–59 points) 4 = Very good (60+ points) Those states that do not have a matrix have been given the lowest possible score. Countries that have a matrix, but have not made it public, were assigned the second lowest score to give credit for estimated levels of implementation.

° Denotes that the indicator or subindicator was scored for both countries with weapons-usable nuclear materials and countries without, but that the scoring scheme for the latter differed.

Indicator or Subindicator	Source	Indicator Definitions and Construction
4.2 Domestic Nuclear Materials Security Legislation*		**The implementation of security measures is rooted in domestic nuclear materials security legislation.**
4.2.1 Convention on the Physical Protection of Nuclear Material (CPPNM) implementation authority*	EIU analyst qualitative assessment based on official national sources, which vary by country	Existence of a national authority (state body) to implement the CPPNM increases the likelihood of implementation and demonstrates commitment to the CPPNM's objectives. Is there a national authority for implementation of the Convention on the Physical Protection of Nuclear Material (CPPNM)? 0 = No 1 = Yes This indicator considers whether or not there is a national authority (state body) that is responsible for implementing the CPPNM. The convention requires states to establish or designate a competent authority responsible for the implementation of the legislative and regulatory framework.
4.2.2 National legal framework for CPPNM*	EIU analyst qualitative assessment based on official national sources, which vary by country	A national legal framework is part of the foundation of a strong system and culture of nuclear materials security. Has the state fulfilled all obligations for a national legal framework for the CPPNM? 0 = No 1 = Yes This indicator assesses whether the legal elements specified by the CPPNM are enshrined in domestic legislation.
4.3 Safeguards Adherence and Compliance*		**States compliant with safeguards measures take seriously responsibilities related to their stewardship of nuclear materials.**
4.3.1 IAEA safeguards agreement (excluding Additional Protocol)°	IAEA	Conclusion of a safeguards agreement demonstrates a state's commitment to its stewardship of nuclear materials. Has the state concluded an IAEA safeguards agreement (excluding the Additional Protocol)? 0 = No 1 = Yes, INFCIRC 66 or Voluntary Offer Agreement (VOA) 2 = Yes, Comprehensive Safeguards Agreement (CSA) The following is the scoring scheme for countries without materials: 0 = No 1 = Yes, Small Quantities Protocol (SQP) 2 = Yes, Modified Small Quantities Protocol 3 = Yes, Comprehensive Safeguards Agreement (CSA)

* Denotes that the indicator or subindicator was scored for both countries with weapons-usable nuclear materials and countries without.

° Denotes that the indicator or subindicator was scored for both countries with weapons-usable nuclear materials and countries without, but that the scoring scheme for the latter differed.

Indicator or Subindicator	Source	Indicator Definitions and Construction
4.3.2 IAEA Additional Protocol*	IAEA	Ratification of the Additional Protocol demonstrates a high level of commitment to a state's stewardship of nuclear materials. Has the state ratified the Additional Protocol? 0 = No 1 = Yes
4.3.3 Facility exclusion from safeguards	EIU analyst qualitative assessment	Exclusion of facilities from safeguards shows a weakening of a state's commitment to its stewardship of nuclear materials. Does the state exclude any enrichment or reprocessing facilities from international and/or European Atomic Energy Community (Euratom) safeguards? 0 = Yes, the state excludes some or all of its enrichment or reprocessing facilities 1 = No, the state does not exclude any of its enrichment or reprocessing facilities or the state does not have an enrichment or reprocessing facility
4.3.4 Safeguards violations*	IAEA	Safeguards violations undermine a state's commitment to its stewardship of nuclear materials. Has the state been reported to the IAEA Board of Governors or the UN Security Council for a violation of its safeguards agreement and do the issues reported therein remain outstanding? 0 = The state has been reported to both the IAEA Board of Governors and the UN Security Council, and issues reported therein remain outstanding 1 = The state has been reported to the IAEA Board of Governors and issues reported therein remain outstanding 2 = The state has never been reported to either the IAEA Board of Governors or the UN Security Council or has been previously reported but no issues remain outstanding
4.4 Independent Regulatory Agency		**A robust and independent regulatory structure helps to ensure compliance with nuclear materials–related regulations.**
4.4.1 Independent Regulatory Agency	EIU analyst qualitative assessment based on official national sources, which vary by country	Does the state have an independent regulatory agency responsible for regulating security? 0 = No 1 = Yes According to the IAEA, this requires "an effective separation between the functions of the regulatory body and those of any other body or organization concerned with the promotion or utilization of nuclear energy."

* Denotes that the indicator or subindicator was scored for both countries with weapons-usable nuclear materials and countries without.

° Denotes that the indicator or subindicator was scored for both countries with weapons-usable nuclear materials and countries without, but that the scoring scheme for the latter differed.

Risk Environment

The Risk Environment can affect the nuclear materials security conditions in a country. This category comprises four indicators: (a) Political Stability, (b) Effective Governance, (c) Pervasiveness of Corruption, and (d) Group(s) Interested in Illicitly Acquiring Materials.

Indicator or Subindicator	Source	Indicator Definitions and Construction
5.1 Political Stability*		**A lack of political stability may enable lapses in nuclear materials security.**
5.1.1 Social unrest*	EIU Risk Briefing	Significant social unrest can affect the government's ability to secure nuclear materials, or the upheaval created by the unrest may provide opportunities for groups that are seeking to acquire nuclear materials to operate. What is the risk of significant social unrest during the next two years? 0 = Very high 1 = High 2 = Moderate 3 = Low 4 = Very low Social unrest can include large-scale demonstrations; political strikes; and inter-ethnic, racial, or religious clashes.
5.1.2 Orderly transfers of power*	EIU Risk Briefing	Instability and conflict surrounding changes of power may provide opportunities for groups seeking to acquire nuclear materials. How clear, established, and accepted are constitutional mechanisms for the orderly transfer of power from one government to another? 0 = Not clear, established, or accepted 1 = Two of the three criteria are absent 2 = One of the three criteria is absent 3 = Clear, established, and accepted 4 = Very clear, established, and accepted Unclear, poorly established, or weakly accepted constitutional mechanisms for the transfer of power are a particular concern for succession in autocracies, but can also prove an issue in more democratic systems, for example, if election results are not accepted by all sides.

* Denotes that the indicator or subindicator was scored for both countries with weapons-usable nuclear materials and countries without.

Indicator or Subindicator	Source	Indicator Definitions and Construction
5.1.3 International disputes or tensions*	EIU Risk Briefing	Tensions with important trade or strategic partners and armed regional conflicts could have destabilizing implications for a country and, hence, for nuclear materials security. Is there a risk that international disputes/tensions will negatively affect the country during the next two years? 0 = Very high 1 = High 2 = Moderate 3 = Low 4 = No threat In addition to armed regional conflict, tensions with important trade or strategic partners, resulting in economic sanctions and/or other barriers to trade, could have destabilizing implications for the country and, hence, for nuclear materials security.
5.1.4 Armed conflict*	EIU Risk Briefing	Armed conflict in areas where nuclear materials are stored could seriously compromise site security. Is this country presently subject to armed conflict, or is there at least a moderate risk of such conflict during the next two years? 0 = Territorial conflict; opposition has effective control over a region or regions 1 = Sporadic and incursive conflict 2 = Incursive conflict; government remains in control, but opposition engages in frequent armed incursions 3 = Sporadic conflict; government control is firm, but opposition engages in isolated incidents of violence 4 = No armed conflict exists This indicator covers armed conflict either within the territory of the state or directly threatening it. Forms of conflict may range from sporadic or incursive conflict with non-state actors to conventional conflict with secessionist entities or other states.
5.1.5 Violent demonstrations or violent civil or labor unrest*	EIU Risk Briefing	Violent demonstrations or civil or labor unrest may compromise government control, and provide opportunities for groups seeking to acquire nuclear materials. Are violent demonstrations or violent civil/labor unrest likely to occur during the next two years? 0 = Very high 1 = High 2 = Moderate 3 = Low 4 = Very low Violent demonstrations or civil or labor unrest may arise from socioeconomic factors such as unemployment or fiscal austerity; ethnic, religious, or political divisions; labor disputes; and refugee or migrant flows.

* Denotes that the indicator or subindicator was scored for both countries with weapons-usable nuclear materials and countries without.

Indicator or Subindicator	Source	Indicator Definitions and Construction
5.2 Effective Governance*		**A lack of effective governance can negatively impact a country's ability to put into place and sustain policies to secure nuclear materials.**
5.2.1 Effectiveness of the political system*	EIU Business Environment Ranking	An ineffective political system can compromise a country's ability to establish and sustain policies to secure nuclear materials. How effective is the country's political system in formulating and executing policy? 0 = Very low 1 = Low 2 = Moderate 3 = High 4 = Very high This indicator assesses tensions between the legislative and executive branches of government; instability in government formation; and cohesion of the legislature.
5.2.2 Quality of the bureaucracy*	EIU Risk Briefing	An ineffective bureaucracy can negatively impact a country's ability to put into place and sustain policies to secure nuclear materials. What is the quality of the country's bureaucracy and its ability to carry out government policy? 0= Very low 1= Low 2= Moderate 3= High 4= Very high This indicator assesses the quality of the bureaucracy across the following criteria: overall competency and training; morale and dedication; and compensation and status.

* Denotes that the indicator or subindicator was scored for both countries with weapons-usable nuclear materials and countries without.

Indicator or Subindicator	Source	Indicator Definitions and Construction
5.3 Pervasiveness of Corruption*		**Corruption affects the potential for theft of nuclear materials and the rigor with which nuclear material security measures are implemented.**
5.3.1 Pervasiveness of corruption*	EIU Risk Briefing	How pervasive is corruption among public officials? 0 = Very high 1 = High 2 = Moderate 3 = Low 4 = Very low The following factors are considered in this assessment: length of time that the regime or government has been in power; number of officials appointed rather than elected; frequency of reports or rumors of bribery; and perception of the degree to which public officials are involved in corrupt practices (e.g., misuse of public office for private benefit, accepting bribes, dispensing favors, and patronage for private gain).
5.4 Group(s) Interested in Illicitly Acquiring Materials*		**The presence and capabilities of terrorist or criminal group(s), particularly those with the goal of illicitly acquiring nuclear materials, raises the risk of theft of nuclear materials.**
5.4.1 Group(s) interested in illicitly acquiring materials*	Economist Intelligence Unit and expert assessment based on various sources	Are there terrorist or criminal group(s) interested in illicitly acquiring nuclear materials? 0 = Such group(s) are present and are thought to have the capabilities to carry out their goals acting alone or with the assistance of a capable third party 1 = Such group(s) are present, but are likely incapable of carrying out their aims 2 = No such group(s) are known to be present

* Denotes that the indicator or subindicator was scored for both countries with weapons-usable nuclear materials and countries without.

Sabotage Countries

Number of Sites

This category comprises one indicator: Number of Sites. The Number of Sites category captures the number of sites in a country that, if subject to an act of sabotage, could pose the risk of a radiological release with significant off-site health consequences.

Indicator or Subindicator	Source	Indicator Definitions and Construction
1.1 Number of Sites		**The greater the number of nuclear facilities, the greater the potential risk of acts of sabotage.**
1.1.1 Number of sites	EIU analyst qualitative assessment	How many sites with nuclear facilities does the country maintain that, if subject to an act of sabotage, could pose the risk of a radiological release with significant off-site health consequences? The following types of nuclear facilities are considered: • Operating nuclear power reactors or nuclear power reactors that have been shut down within the last five years • Research reactors with a capacity of 2MW or greater • Reprocessing facilities • Spent fuel pools, only if the fuel has been discharged in the last five years and is not associated with an operating reactor. 0= 30 sites or greater 1= 20-29 sites 2 = 10-19 sites 3= 4-9 sites 4= 2-3 sites 5= One site A location with multiple facilities onsite is counted as a single site.

Security and Control Measures

The Security and Control Measures category encompasses the core activities directly related to protection of nuclear facilities. This category comprises five indicators: On-site Physical Protection, Control and Accounting Procedures, Insider Threat Prevention, Response Capabilities, and Cybersecurity.

Indicator or Subindicator	Source	Indicator Definitions and Construction
2.1 On-Site Physical Protection		**Essential measures for securing sites and facilities.**
2.1.1 Mandatory physical protection	EIU analyst qualitative assessment based on official national sources, which vary by country	Requiring licensees to provide physical protection increases the likelihood that nuclear facilities will meet strict standards. Is physical protection a condition for licensing? 0 = No *or* information not publicly available 1 = Yes

Indicator or Subindicator	Source	Indicator Definitions and Construction
2.1.2 On-site reviews of security	EIU analyst qualitative assessment based on official national sources, which vary by country	On-site reviews of security increase the likelihood that physical protection measures meet prescribed standards and will be maintained. Are on-site reviews of security done in order to keep a license? 0 = No *or* information not publicly available 1 = Yes
2.1.3 Design Basis Threat (DBT)	EIU analyst qualitative assessment based on official national sources, which vary by country	A Design Basis Threat based on strong assumptions and that is regularly updated leads to a more rigorous security system. Do the country's regulations require the use of a Design Basis Threat that is required to be updated? 0 = No *or* information not publicly available 1 = Yes A Design Basis Threat means the attributes and characteristics of potential insider or external adversaries who might attempt unauthorized removal of nuclear material or sabotage against which a physical protection system is designed and evaluated.
2.1.4 Security responsibilities and accountabilities	EIU analyst qualitative assessment based on official national sources, which vary by country	Requiring licensees to hold particular individuals accountable for security increases the likelihood that physical protection measures will be implemented. Does the nuclear regulator define nuclear security responsibilities and accountabilities? 0 = No *or* information not publicly available 1 = Yes This subindicator seeks to answer whether the regulator requires licensees to define who is responsible and/or accountable for at least one aspect of nuclear security. It is not enough to note that the responsibility for security will fall to the licensee. The regulator should require that the licensee have individuals with security responsibilities or accountabilities in at least one area of security.
2.1.5 Performance-based program	EIU analyst qualitative assessment based on official national sources, which vary by country	Required demonstration of performance, along with tests and assessments, improves effectiveness of and identifies weaknesses in physical protection measures. Does the regulator require a performance-based program, which includes tests and assessments of security systems and measures, and a demonstration of performance by security personnel at nuclear sites? 0 = No *or* information not publicly available 1 = Yes

Indicator or Subindicator	Source	Indicator Definitions and Construction
2.2 Control and Accounting Procedures		**Control and accounting is a necessary element of a comprehensive security system.**
2.2.1 Legal and regulatory basis for material control and accounting (MC&A)	EIU analyst qualitative assessment based on official national sources, which vary by country	A legal and regulatory basis for control and accounting is part of the foundation of a strong system and culture of nuclear security. Is there a domestic legal and regulatory basis for nuclear material control and accounting (MC&A)? 0 = There is no domestic legal or regulatory basis for MC&A or information not publicly available 1 = There is a legal and regulatory basis for MC&A 2 = There is a legal and regulatory basis for MC&A and international guidelines are reflected in the legal and regulatory system
2.2.2 Radiological consequences (materials)	EIU analyst qualitative assessment based on official national sources, which vary by country	A graded approach that identifies different levels of security ensures that security measures are commensurate with the potential consequences of an act of sabotage. Do domestic laws, regulations, or licensing requirements require that the potential levels of radiological consequences of sabotage be used to determine physical protection of nuclear materials? 0 = No *or* information not publicly available 1 = Yes
2.2.3 Radiological consequences (equipment, systems, and devices)	EIU analyst qualitative assessment based on official national sources, which vary by country	A graded approach that identifies different levels of security ensures that security measures for equipment, systems, and devices are commensurate with the potential consequences of an act of sabotage. Do domestic laws, regulations, or licensing requirements require that potential levels of radiological consequences of sabotage be used to determine physical protection of equipment, systems, and devices? 0 = No *or* information not publicly available 1 = Yes

Indicator or Subindicator	Source	Indicator Definitions and Construction
2.2.4 Control measures	EIU analyst qualitative assessment based on official national sources, which vary by country	Control measures aid in the assurance that unauthorized access to restricted areas of nuclear facilities is detected in a timely manner. Do domestic regulations or licensing conditions require the following control measures? a. The identity of persons entering areas with nuclear material; and/or areas with equipment, systems, and devices the sabotage of which could lead to high radiological consequences (the equivalent of a "vital area" as defined by the IAEA), must be verified. b. Records must be kept of all persons who access areas with nuclear material; and/or areas with equipment, systems, and devices the sabotage of which could lead to high radiological consequences (the equivalent of a "vital area" as defined by the IAEA), and of all persons who have access to or possession of keys, keycards and other systems—including computer systems—that control access to such areas. 0 = Regulations do not require control measures or information not publicly available 1 = Regulations require one of these control measures 2 = Regulations require two of these control measures
2.2.5 Access control	EIU analyst qualitative assessment based on official national sources, which vary by country	Effective access control measures increase the likelihood of the detection and prevention of unauthorized access to restricted areas of nuclear facilities. Is access to areas with nuclear material; and/or areas with equipment, systems, and devices the sabotage of which could lead to high radiological consequences (the equivalent of a "vital area" as defined by the IAEA), limited to persons with authorized access? 0= No *or* information not publicly available 1= Yes
2.3 Insider Threat Prevention		**The qualifications of personnel, the strength of the security culture, and the use of certain surveillance measures are critical to how well security procedures are followed and decrease vulnerability to insider threats.**
2.3.1 Personnel vetting	EIU analyst qualitative assessment based on official national sources, which vary by country	Clear guidelines for the qualification and fitness of personnel increase the likelihood that security and other personnel with access to protected areas will effectively discharge their responsibilities and decreases vulnerability to insider threats. Do domestic regulations or license conditions specify that security and other personnel with access to protected areas are subject to the following checks: drug testing, background checks, and psychological or mental fitness checks? 0 = Personnel are not subject to any of these checks 1 = Personnel are subject to one of these checks 2 = Personnel are subject to two of these checks 3 = Personnel are subject to all three of these checks

Indicator or Subindicator	Source	Indicator Definitions and Construction
2.3.2 Frequency of personnel vetting	EIU analyst qualitative assessment based on official national sources, which vary by country	Personnel vetting at frequent intervals is essential to identifying new and changing insider threats. Do domestic regulations or licensing conditions specify that security and other personnel with access to protected areas are vetted at specified intervals? 0 = Frequency of vetting is not specified or information not publicly available 1 = Such personnel are subject to vetting at periods greater than five (5) years 2 = Such personnel are subject to vetting at periods greater than two (2) but not more than five (5) years 3= Such personnel are subject to vetting at periods of two (2) years or less
2.3.3 Reporting	EIU analyst qualitative assessment based on official national sources, which vary by country	Requiring personnel to report suspicious behavior increases the likelihood that insider threats will be detected early. Do domestic regulations or licensing conditions specify that personnel must report suspicious behavior to an official authority? 0 = No *or* information not publicly available 1 = Yes
2.3.4 Surveillance	EIU analyst qualitative assessment based on official national sources, which vary by country	To counter the insider threat, whenever a protected area is occupied, constant surveillance (e.g., a two-person surveillance system or technological surveillance system) should be used to achieve detection of unauthorized action. Do domestic regulations or license conditions require constant surveillance of areas with nuclear material and/or areas with equipment, systems, and devices, the sabotage of which could lead to high radiological consequences (the equivalent of a "vital area" as defined by the IAEA), when they are occupied using either a two-person surveillance system or a technological surveillance system? 0 = No or information not publicly available 1 = Yes, a two-person surveillance system or a technological surveillance system is required 2 = Yes, both a two-person surveillance system and a technological surveillance system are required *Two-person surveillance system:* Requires at least two knowledgeable persons to be present to verify that activities involving nuclear material and nuclear facilities are authorized, allowing detection of access or actions that are unauthorized. *Technological surveillance:* Technological surveillance includes devices such as closed-circuit television (CCTV) and audio surveillance equipment.

Indicator or Subindicator	Source	Indicator Definitions and Construction
2.4 Response Capabilities		**Response capabilities are part of a layered security system to prevent and mitigate acts of sabotage.**
2.4.1 Emergency response capabilities	EIU analyst qualitative assessment based on official national sources, which vary by country	Requiring on-site emergency response capabilities, including trained response teams and required incident reports (i.e., notification), increases the level of preparedness for potential acts of sabotage. Do the state's licensing requirements for civilian nuclear facilities require that each facility have on-site nuclear security emergency response capabilities? 0 = Licensing does not require an on-site trained response team or incident reports to appropriate law enforcement authority 1 = Licensing requires incident reports to appropriate law enforcement authority 2 = Licensing requires an on-site trained response team 3 = Licensing requires both an on-site trained response team and incident reports to appropriate law enforcement authority Capabilities should include a trained response team and a requirement to report an incident to appropriate law enforcement authorities.
2.4.2 Armed response capabilities	EIU analyst qualitative assessment based on official national sources, which vary by country	Requiring on-site armed response capabilities increases the chance of success in responding to armed attacks. Do the state's licensing requirements for civilian nuclear facilities require that each nuclear power reactor and reprocessing facility have an on-site armed response team? 0 = No *or* information not publicly available 1 = Yes, an on-site armed response team is required or the state does not have a nuclear power reactor or reprocessing facility
2.4.3 Law enforcement response training	EIU analyst qualitative assessment based on official national sources, which vary by country	Law enforcement officers who are trained to respond to security incidents at nuclear facilities have a greater chance of success responding to those incidents than those who are untrained. Are law enforcement trained to respond in the event of a security incident at a nuclear facility? 0 = No 1 = Yes
2.4.4 Nuclear infrastructure protection plan	EIU analyst qualitative assessment based on official national sources, which vary by country	Natural disasters may increase vulnerability of nuclear facilities as a result of physical damage to facilities and additional pressures placed upon government and personnel. Does the country's regulatory framework state that, in the event of a natural disaster, plans are in place to physically protect the nuclear infrastructure? 0 = No mention 1 = Partially mentioned 2 = Fully described Emergency preparedness regulations must mention nuclear facilities specifically.

Indicator or Subindicator	Source	Indicator Definitions and Construction
2.5 Cybersecurity		**Nuclear facilities are vulnerable to cyber attacks as well as physical attacks. Therefore, cybersecurity is a critical component to protecting against acts of sabotage.**
2.5.1 Mandatory cybersecurity	EIU analyst qualitative assessment based on official national sources, which vary by country	Requiring nuclear facilities to have protection from a cyber attack increases the likelihood that nuclear facilities will take measures to protect against cyber attacks. Do domestic laws, regulations, or licensing requirements require nuclear facilities to have protection from a cyber attack? 0 = No *or* information not publicly available 1 = Yes
2.5.2 Critical digital asset protection	EIU analyst qualitative assessment based on official national sources, which vary by country	Requiring protection of critical digital assets against cyber attacks decreases the chance that an attacker can circumvent physical protection, control and accounting, and safety systems. Do domestic laws, regulations, or licensing requirements require nuclear facilities to protect critical digital assets from a cyber attack? 0 = No *or* information not publicly available 1 = Yes Critical digital assets include the following systems and networks: • Safety-related functions • Security functions • Emergency preparedness functions • Support systems and equipment related to the above functions.
2.5.3 Cybersecurity Design Basis Threat	EIU analyst qualitative assessment based on official national sources, which vary by country	Requiring that the Design Basis Threat take into account the potential for cyber attacks increases the likelihood that nuclear facilities will consider cyber attacks when designing their security plans. Does the state consider cyber threats in its threat assessment or Design Basis Threat for nuclear facilities? 0 = No *or* information not publicly available 1 = Yes
2.5.4 Cybersecurity assessments	EIU analyst qualitative assessment based on official national sources, which vary by country	Required demonstration of performance, along with tests and assessments, improves effectiveness of and identifies weaknesses in cybersecurity measures. Does the regulator require a performance-based program, which includes tests and assessments of cybersecurity at nuclear facilities? 0 = No *or* information not publicly available 1 = Yes

Indicator or Subindicator	Source	Indicator Definitions and Construction
2.5.5 Cyber incident response plan	EIU analyst qualitative assessment based on official national sources, which vary by country	Requiring an incident response plan (a plan of action to respond) for a cyber security incident or cyber attack at nuclear facilities helps to contain the impact and reduce recovery times. Do domestic laws, regulations, or licensing requirements require a cyber-incident response plan for nuclear facilities? 0 = No *or* information not publicly available 1 = Yes

Global Norms

The Global Norms category includes actions that contribute to the establishment of global norms for nuclear security. This category comprises three indicators: (a) International Legal Commitments, (b) Voluntary Commitments, and (c) International Assurances.

Indicator or Subindicator	Source	Indicator Definitions and Construction
3.1 International Legal Commitments		**International legal commitments are the basis for domestic legislation, regulations, and security capacity.**
3.1.1 Convention on the Physical Protection of Nuclear Material (CPPNM)	International Atomic Energy Agency (IAEA)	Parties to the CPPNM commit to provide certain levels of physical protection during international transport of nuclear materials; cooperate in the protection, recovery, and return of stolen nuclear material; and criminalize offenses involving nuclear material. The CPPNM is the basis for the 2005 Amendment, which requires protection of nuclear facilities against sabotage. Is the state a party to the CPPNM? 0 = Non-compliant *or* not a member 1 = Signed 2 = Signed and ratified (or action having the same legal effect)
3.1.2 2005 Amendment to the CPPNM	IAEA	Parties to the 2005 Amendment to the CPPNM commit to expand the scope of their responsibilities under the CPPNM to include protection of nuclear material in domestic use, in storage, and during transport, as well as protection of nuclear facilities against acts of sabotage. Is the state a party to the 2005 CPPNM? 0 = Not ratified, accepted, or approved 1 = Ratified, accepted, or approved (or action having the same legal effect)
3.1.3 International Convention for the Suppression of Acts of Nuclear Terrorism (ICSANT)	United Nations	Parties to the ICSANT commit to criminalize acts of nuclear terrorism and promote cooperation with other states to prevent, investigate, and punish those acts. Is the state a party to ICSANT? 0 = Non-compliant *or* not a member 1 = Signed 2 = Signed and ratified (or action having the same legal effect)

Indicator or Subindicator	Source	Indicator Definitions and Construction
3.1.4 Convention on Nuclear Safety	IAEA	Parties to the Convention on Nuclear Safety commit to provide high levels of nuclear safety and defend nuclear installations against potential radiological hazards and prevent and mitigate radiological accidents. These steps also minimize the risks associated with acts of sabotage against nuclear facilities. Is the state a party to the Convention on Nuclear Safety? 0 = Non-compliant *or* not a member 1 = Signed 2 = Signed and ratified (or action having the same legal effect)
3.2 Voluntary Commitments		**Voluntary commitments demonstrate a state's support for nuclear security as a global agenda.**
3.2.1 International Atomic Energy Agency (IAEA) membership	IAEA	Is the country a member of the IAEA? 0 = No 1 = Yes
3.2.2 Global Initiative to Combat Nuclear Terrorism (GICNT) membership	U.S. Department of State	Is the country a member of GICNT? 0 = No 1 = Yes
3.2.3 Global Partnership Against the Spread of Weapons and Materials of Mass Destruction membership	U.S. Department of State	Is the country a member of the Global Partnership Against the Spread of Weapons and Materials of Mass Destruction? 0 = No 1 = Yes
3.2.4 World Institute for Nuclear Security (WINS) contributions	WINS Annual Report 2016, 2017, and 2018	Has the country provided financial or in-kind contributions to the WINS within the previous two years? 0 = No 1 = Yes
3.2.5 IAEA Nuclear Security Fund contributions	IAEA	Has the country provided financial or in-kind contributions to the IAEA Nuclear Security Fund within the previous two years? 0 = No 1 = Yes
3.2.6 Bilateral or multilateral assistance	EIU analyst qualitative assessment	Has the country provided financial and/or practical bilateral or multilateral assistance for other states or received such assistance in the field of nuclear security (exclusive of contributions captured elsewhere in this indicator) within the previous two years? 0 = No 1 = Yes

Indicator or Subindicator	Source	Indicator Definitions and Construction
3.2.7 Centers of Excellence	EIU analyst qualitative assessment	Does the country have a Center of Excellence or Nuclear Security Training and Support Center that offers training in nuclear security? 0 = No 1 = Yes To receive credit, a Center of Excellence or Nuclear Security Training and Support Center should have the following characteristics: (a) serve as a centralized organization to facilitate broad cross-industry engagement in education and training; (b) focus on nuclear security, even if safeguards, safety or nuclear energy are also addressed; (c) provide practical training courses; (d) provide education in the form of lectures or seminars; and (e) have government support. Centers that are not yet operational are excluded.
3.3 International Assurances		**International assurances enhance international confidence in the effectiveness of a country's nuclear security conditions.**
3.3.1 Published regulations and reports	EIU analyst qualitative assessment based on official national sources, which vary by country	Public release of broad outlines of nuclear security regulations and nuclear security issues increases confidence in a country's commitment to nuclear security. Does the state publicly release broad outlines of its nuclear security regulations and/or annual reports on nuclear security issues? 0 = The state does not publish regulations or annual reports 1 = The state publishes regulations *or* an annual report 2 = The state publishes regulations *and* an annual report
3.3.2 Review of security arrangements	EIU analyst qualitative assessment	Hosting security reviews demonstrates the importance a country places on its security obligations and creates international confidence in levels of security. Has the state hosted a review of its security arrangements? 0 = No 1 = Yes 2 = Yes, within the past five years A state receives credit if it has hosted any of the following IAEA missions, including follow-up missions: International Physical Protection Advisory Service (IPPAS) mission; International Nuclear Security Advisory Service (INSServ) mission; State System for Accountancy and Control (SSAC) Advisory Service; or Integrated Regulatory Review Service (IRRS) missions that have a security component. A state receives a "yes" if it has received bilateral or multilateral assistance (outside an international organization) to review security arrangements.

Domestic Commitments and Capacity

The Domestic Commitments and Capacity category includes actions that indicate how well a country has implemented its international commitments and a country's capacity to do so. This category comprises three indicators: (a) UN Security Council Resolution (UNSCR) 1540 Implementation, (b) Domestic Nuclear Security Legislation, and (c) Independent Regulatory Agency.

Indicator or Subindicator	Source	Indicator Definitions and Construction
4.1 UN Security Council Resolution (UNSCR) 1540 Implementation		**UNSCR 1540 obliges action on nuclear security, and its implementation demonstrates a state's commitment level.**
4.1.1 UNSCR 1540 reporting	Security Council Committee established pursuant to resolution 1540 (1540 Committee)	Compliance with UNSCR 1540 reporting requirements demonstrates commitment to UNSCR 1540's security objectives. Has the state provided the required UNSCR 1540 report to the Security Council Committee established pursuant to resolution 1540 (1540 Committee)? 0 = The state has not provided a UNSCR 1540 report 1 = The state has provided a UNSCR 1540 report
4.1.2 Extent of UNSCR 1540 implementation	Creation of a coding and scoring scheme by the Economist Intelligence Unit (EIU), based on documents from the 1540 Committee	Implementation of UNSCR 1540 demonstrates commitment to UNSCR 1540's security objectives and improves security procedures and culture. Extent of implementation is identified through the measures taken by a state and reflected in its UNSCR 1540 matrix. Scoring is based on an evaluation of the total number of elements of UNSCR 1540 that have been implemented as reflected in the individual country matrices. Elements related to nuclear security in the matrix that have been implemented are indicated by an "X." The EIU summed the number of elements related to the security of nuclear facilities against sabotage (out of a maximum of 25) with an "X" designation, providing a numerical score for implementation. The resulting numerical score is banded into five categories scored from 0 points to 4 points: 0= Very weak (0-5 points) 1= Weak (6-10 points) or matrix exists but is not publicly available 2= Moderate (11-15 points) 3= Good (16-20 points) 4= Very good (21+ points) Those states that do not have a matrix have been given the lowest possible score. Countries that have a matrix, but have not made it public, were assigned the second lowest score to give credit for estimated levels of implementation.

Indicator or Subindicator	Source	Indicator Definitions and Construction
4.2 Domestic Nuclear Security Legislation		**The implementation of security measures is rooted in domestic nuclear security legislation.**
4.2.1 Convention on the Physical Protection of Nuclear Material (CPPNM) implementation authority	EIU analyst qualitative assessment based on official national sources, which vary by country	Existence of a national authority (state body) to implement the CPPNM increases the likelihood of implementation and demonstrates commitment to the CPPNM's objectives. Is there a national authority for implementation of CPPNM? 0 = No 1 = Yes This indicator considers whether or not there is a national authority (state body) that is responsible for implementing the CPPNM. The convention requires states to establish or designate a competent authority responsible for the implementation of the legislative and regulatory framework.
4.2.2 National legal framework for CPPNM	EIU analyst qualitative assessment based on official national sources, which vary by country	A national legal framework is part of the foundation of a strong system and culture of nuclear security. Has the state fulfilled all obligations for a national legal framework for the CPPNM? 0 = No 1 = Yes This indicator determines whether the legal elements specified by the CPPNM are enshrined in domestic legislation.
4.2.3 Convention on Nuclear Safety report	International Atomic Energy Agency (IAEA)	Compliance with Convention on Nuclear Safety reporting requirements demonstrates commitment to the Convention on Nuclear Safety's security objectives. Has the state provided the required report to the IAEA in conjunction with the most recent review meeting on measures taken to implement the Convention on Nuclear Safety? 0= No 1= Yes *or* the state does not have a nuclear power reactor
4.3 Independent Regulatory Agency		**A robust and independent regulatory structure helps to ensure compliance with nuclear security-related regulations.**
4.3.1 Independent regulatory agency	EIU analyst qualitative assessment based on official national sources, which vary by country	Does the state have an independent regulatory agency responsible for regulating security? 0 = No 1 = Yes According to the IAEA, this requires "an effective separation between the functions of the regulatory body and those of any other body or organization concerned with the promotion or utilization of nuclear energy."

Risk Environment

The Risk Environment can affect the nuclear security conditions in a country. This category comprises four indicators: (a) Political Stability, (b) Effective Governance, (c) Pervasiveness of Corruption, and (d) Group(s) Interested in Committing Acts of Nuclear Terrorism.

Indicator or Subindicator	Source	Indicator Definitions and Construction
5.1 Political Stability		**A lack of political stability may enable lapses in nuclear security.**
5.1.1 Social unrest	EIU Risk Briefing	Significant social unrest can affect the government's ability to secure nuclear facilities, or the upheaval created by the unrest may provide opportunities for groups seeking to commit acts of sabotage against nuclear facilities. What is the risk of significant social unrest during the next two years? 0 = Very high 1 = High 2 = Moderate 3 = Low 4 = Very low Social unrest can include large-scale demonstrations; political strikes; and inter-ethnic, racial, or religious clashes.
5.1.2 Orderly transfers of power	EIU Risk Briefing	Instability and conflict surrounding changes of power may provide opportunities for groups seeking to commit acts of sabotage against nuclear facilities. How clear, established, and accepted are constitutional mechanisms for the orderly transfer of power from one government to another? 0 = Not clear, established, or accepted 1 = Two of the three criteria are absent 2 = One of the three criteria is absent 3 = Clear, established, and accepted 4 = Very clear, established, and accepted Unclear, poorly established, or weakly accepted constitutional mechanisms for the transfer of power are a particular concern for succession in autocracies, but can also prove an issue in more democratic systems, for example, if election results are not accepted by all sides.

Indicator or Subindicator	Source	Indicator Definitions and Construction
5.1.3 International disputes or tensions	EIU Risk Briefing	Tensions with important trade or strategic partners and armed regional conflicts could have destabilizing implications for a country and, hence, for nuclear security. Is there a risk that international disputes/tensions will negatively affect the country during the next two years? 0 = Very high 1 = High 2 = Moderate 3 = Low 4 = No threat In addition to armed regional conflict, tensions with important trade or strategic partners, resulting in economic sanctions and/or other barriers to trade, could have destabilizing implications for the country and, hence, for nuclear security.
5.1.4 Armed conflict	EIU Risk Briefing	Armed conflict in areas where nuclear facilities are located could seriously compromise site security. Is this country presently subject to armed conflict, or is there at least a moderate risk of such conflict during the next two years? 0 = Territorial conflict; opposition has effective control over a region or regions 1 = Sporadic and incursive conflict 2 = Incursive conflict; government remains in control, but opposition engages in frequent armed incursions 3 = Sporadic conflict; government control is firm, but opposition engages in isolated incidents of violence 4 = No armed conflict exists This indicator covers armed conflict either within the territory of the state or directly threatening it. Forms of conflict may range from sporadic or incursive conflict with non-state actors to conventional conflict with secessionist entities or other states.
5.1.5 Violent demonstrations or violent civil or labor unrest	EIU Risk Briefing	Violent demonstrations or civil or labor unrest may compromise government control, and provide opportunities for groups seeking to commit acts of sabotage against nuclear facilities. Are violent demonstrations or violent civil or labor unrest likely to occur during the next two years? 0 = Very high 1 = High 2 = Moderate 3 = Low 4 = Very low Violent demonstrations or civil or labor unrest may arise from socioeconomic factors such as unemployment or fiscal austerity; ethnic, religious, or political divisions; labor disputes; and refugee or migrant flows.

Indicator or Subindicator	Source	Indicator Definitions and Construction
5.2 Effective Governance		**A lack of effective governance can compromise a country's ability to establish and sustain policies to secure nuclear facilities.**
5.2.1 Effectiveness of the political system	EIU Business Environment Ranking	An ineffective political system can compromise a country's ability to establish and sustain policies to secure nuclear facilities. How effective is the country's political system in formulating and executing policy? 0 = Very low 1 = Low 2 = Moderate 3 = High 4 = Very high This indicator assesses tensions between the legislative and executive branches of government; instability in government formation; and cohesion of the legislature.
5.2.2 Quality of the bureaucracy	EIU Risk Briefing	An ineffective bureaucracy can compromise a country's ability to establish and sustain policies to secure nuclear facilities. What is the quality of the country's bureaucracy and its ability to carry out government policy? 0= Very low 1= Low 2= Moderate 3= High 4= Very high This indicator assesses the quality of the bureaucracy across the following criteria: overall competency and training; morale and dedication; and compensation and status.
5.3 Pervasiveness of Corruption		**Corruption affects the potential for acts of sabotage and the rigor with which nuclear security measures are implemented.**
5.3.1 Pervasiveness of corruption	EIU Risk Briefing	How pervasive is corruption among public officials? 0 = Very high 1 = High 2 = Moderate 3 = Low 4 = Very low The following factors are considered in this assessment: length of time that the regime or government has been in power; number of officials appointed rather than elected; frequency of reports or rumors of bribery; and perception of the degree to which public officials are involved in corrupt practices (e.g., misuse of public office for private benefit, accepting bribes, dispensing favors, and patronage for private gain).

Indicator or Subindicator	Source	Indicator Definitions and Construction
5.4 Group(s) Interested in Committing Acts of Nuclear Terrorism		**The presence and capabilities of terrorist or criminal groups, particularly those with the goal of committing acts of nuclear terrorism, raises the risk of sabotage.**
5.4.1 Group(s) interested in committing acts of nuclear terrorism	EIU and expert assessment based on various sources	Are there terrorist or criminal group(s) interested in committing acts of nuclear terrorism? 0= Such group(s) are present and are thought to have the capabilities to carry out their goals acting alone or with the assistance of a capable third party 1= Such group(s) are present, but are likely incapable of carrying out their aims 2= No such group(s) are known to be present

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