ENERGY
RESOURCES
INTERNATIONAL, INC.

ERI-2142.18-1501

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U.S. Department of Energy
Office of Nuclear Energy

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NOTICE

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DISCLAIMER

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1. Introduction

Section 3112(d) of the United States Enrichment Corporation (USEC) Privatization Act requires the U.S. Department of Energy (DOE), when applicable, to ensure that prior to covered sales or transfers of natural or low-enriched uranium, the Secretary of Energy determines that those transfers will not have an adverse material impact on the domestic uranium mining, conversion or enrichment industry (Secretarial Determination).

Section 306(a) of Title III, Division D of the Consolidated and Further Continuing Appropriations Act of 2015 requires that:

> *Any determination (including a determination made prior to the date of enactment of this Act) by the Secretary of Energy under section 3112(d)(2)(B) of the USEC Privatization Act (110 Stat. 1321-335), as amended, shall be valid for not more than 2 calendar years subsequent to such determination.*

The most recent multi-year Secretarial Determination for the sale or transfer of natural or low-enriched uranium was issued by the Secretary of Energy on May 15, 2014 (May 2014 Determination). It covered DOE transfers that were, at that time, planned by DOE through 2022.

DOE requested that Energy Resources International, Inc. (ERI) perform an additional analysis of the potential effects on the domestic uranium mining, conversion and enrichment industries of the introduction of DOE excess uranium inventories in various forms and quantities during calendar years (CYs) 2015 through 2024. This analysis supplements and updates the April 2014 ERI market analysis[1] performed prior to the May 2014 Determination.

The current analysis is based on DOE's contemplated uranium sales and transfers during the period 2015 to 2024, using information concerning quantities and schedules provided to ERI by DOE. The sales and transfers include ongoing transfers of natural UF_6 by DOE's Office of Environmental Management (EM) to the DOE contractor, Fluor-B&W Portsmouth LLC (FBP), for services being provided to DOE in support of the environmental cleanup of the Portsmouth gaseous diffusion plant (GDP); transfers of low enriched uranium (LEU) resulting from the down blending of HEU by the National Nuclear Security Administration (NNSA); prior and additional new transfers of off-spec HEU in the Blended Low-Enriched Uranium (BLEU) program with the Tennessee Valley Authority (TVA); the prior transfer of high assay depleted uranium tails (DUF_6) to Energy Northwest (ENW); and the proposed transfer of additional DUF_6 and off-spec non-UF_6 currently under negotiation with selected companies, as a result of earlier DOE Requests For Offers

[1] Energy Resources International, "2014 Review of the Potential Impact of DOE Excess Uranium Inventory On the Commercial Markets", ERI-2142.17-1401, April 25, 2014.

(RFOs).[2] The quantities used in the April 2014 ERI market analysis have been updated to reflect DOE's current considerations regarding transfers in the near term. While the prior DOE transfers of off-spec HEU to TVA and the transfer of DUF_6 to ENW have already taken place, this material will be loaded into commercial reactors over a period of many years. For purposes of evaluating the effect of these prior transfers on the commercial markets and U.S. industry, ERI continues to find it appropriate to evaluate the effects of this material according to the schedule of the delivery of the processed inventory as reactor fuel, adjusted for industry standard lead times.

Section 2 provides updated background information on each of the nuclear fuel markets - uranium concentrates, conversion services, and enrichment services - that would potentially be affected by DOE inventory. For each of these markets, both spot and term price indicators are presented as well as a projected supply-demand balance. The discussion focuses on changes since April 2014.

Section 3 identifies and discusses the quantities of DOE-attributable natural uranium equivalent and enrichment services expected to affect the commercial markets during the time period addressed by this analysis (2015 - 2024). The categories of material include (i) historical DOE transfers, the uranium from which will continue to displace commercial supply in the market in the future, (ii) planned inventory transfers in exchange for services (barters), for which DOE is specifically assessing whether a determination under § 3112(d) would be sound, and (iii) proposed transfers of additional DUF_6, off-spec LEU, and off-spec non-UF_6 that are currently under negotiation with selected companies as a result of earlier DOE RFOs. Three scenarios, which were provided to ERI by DOE, are examined, rather than the single scenario examined in the April 2014 ERI market analysis. The three scenarios demonstrate the sensitivity of the commercial markets to a range of possible DOE transfer rates.

Section 4 presents quantitative and qualitative estimates of the potential effect of the introduction of these DOE materials and services into the domestic uranium, conversion and enrichment markets. The potential effect is evaluated using market clearing price analysis[3], as well as an econometric model of the spot market price for uranium concentrates. In addition to addressing the effect of DOE inventory on market clearing price, other metrics associated with the domestic industries are evaluated including: employment, production, volumes of inventory relative to market volumes, market capitalization, realized prices and production costs for the uranium production industry;

[2] U. S. DOE, Portsmouth/Paducah Project Office, Request for Offers for the Sale of Depleted and Off-Specification Uranium Hexafluoride Inventories, Request for Offers Number: DE-SOL-0005845, July 3, 2013.

[3] In any particular year, the market clearing price (or equilibrium price) for uranium concentrates, for example, is based on the cost of production of the last increment of uranium that must be supplied by the market in order to provide the total quantity of uranium concentrates that is demanded by the market during that year.

and U.S. converter sales volumes, production costs and workforce reductions; and effect on volumes of enrichment services.

Section 5 provides a final summary of the potential market effects developed in this report.

2. Background on Nuclear Fuel Supply Markets

In order to better understand the potential effects that DOE inventory entering the commercial markets could have for nuclear fuel materials and services, it is useful to have some background regarding the current status of the world markets for uranium, conversion services and UF_6, and enrichment services and EUP.

The ERI Reference Nuclear Power Growth[4] forecasts of installed nuclear generating capacity and the associated requirements for nuclear fuel that is used in this analysis were developed on a plant-by-plant and country-by-country basis. ERI considers its Reference forecast to be the most likely scenario for the development of nuclear power worldwide through 2035. The ERI Reference forecasts reflect the temporary closure of nuclear power plants in Japan and permanent closure of plants in Germany following the March 2011 accident at the Fukushima Daiichi nuclear power plant. In addition, ERI's forecasts reflect recent and expected early closures of nuclear power plants in the U.S. for economic and other reasons, plants under construction in the U.S. and worldwide, and planned nuclear power program growth. The Reference forecast for total world nuclear power generation capacity is consistent with a steady average annual nuclear capacity growth rate of 2% through 2035, with related growth in nuclear fuel requirements. Growth in the U.S. remains relatively flat through 2035, with the strongest growth expected to take place in China, India, Korea, and Russia.

The nuclear power forecasts, nuclear fuel design, and management parameters for specific types of nuclear power plants are used to project future nuclear fuel material and services requirements. The requirements for each U.S. nuclear power plant now operating or under construction take into account plant specific discharge burn-up, reload fuel assays, fuel cycle lengths, first-core and reload lead times, and operating capacity factors. Generic plant type and country-specific operating and fuel cycle characteristics are used for nuclear power plants outside the U.S., and fuel recycle is included for specific countries in Western Europe, consistent with present and planned activities. It should be noted that, worldwide, not all reactors are light-water reactors that utilize enriched uranium. As such the requirements for uranium, conversion services and enrichment services are dependent upon the specific nuclear fuel designs for each reactor.

The nuclear fuel market over-supply situation described in the April 2014 ERI market analysis remains fundamentally unchanged. ERI's Reference forecasts of world nuclear fuel requirements are somewhat lower than the forecasts in the April 2014 ERI market analysis through 2024. The reduction in nuclear fuel requirements in the near term in ERI's updated forecast is due to the slower pace assumed for the restart of Japanese reactors, while the reduction between 2020 and 2024 is due to a reduced contribution by nuclear in France. The longer term increase is associated with an improved outlook for the development of nuclear power in Russia, Turkey and a few other nuclear newcomers.

[4] ERI, 2014 Nuclear Fuel Cycle Supply and Price Report, Update, ERI-2006-1402, November 2014. Not publicly available, available only through subscription.

Since April 2014, there have also been some changes to uranium supply forecasts that are reflected herein.

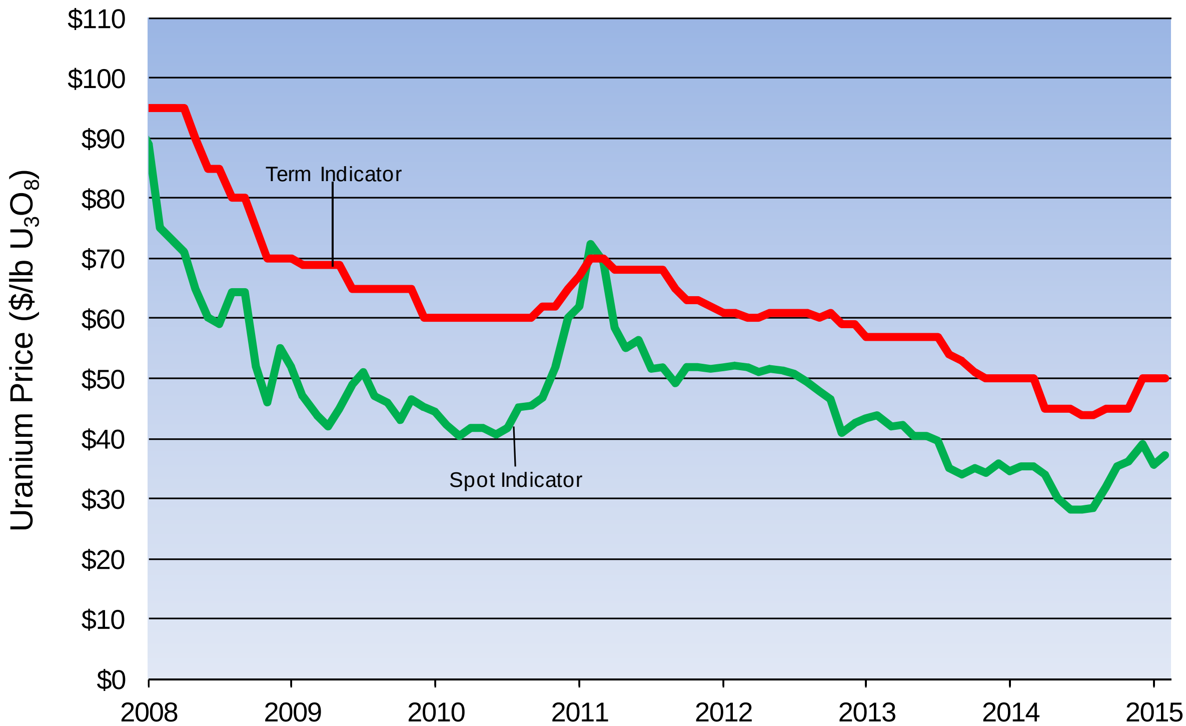
2.1 Uranium Concentrates

2.1.1 Uranium Market Price Activity

Figure 2.1 provides uranium market price indicators updated to include activity between March 31, 2014 and November 30, 2014.[5] As we noted in the April 2014 report, the spot market price, which hit a high of $135 per pound in June 2007, began to fall thereafter, reaching $47 by January 2009. While the rate slowed, the spot price continued in a downward direction, reaching a low of $40.50 per pound U_3O_8 in February 2010. Spot price once again started rising rapidly, rebounding to $72.25 in January 2011 based on renewed enthusiasm for nuclear power's future prospects. Following the accident at Fukushima Daiichi in March 2011, the spot price began to decline once again, reaching $34 per pound by March 2014. The spot market indicator, declined to $28/lb for the period May through July 2014 but then bouncing back to $35/lb in September and $39/lb in November 2014. Weekly prices in November were particularly volatile, peaking as high as $44/lb before settling at $39/lb by month's end. As of January 31, 2015, the North American spot market indicator was $37.25 per pound, a net increase of $3.25/lb (9.6%) has occurred since the end of March 2014.

As noted in the April 2014 report, the term (also referred to as long-term) contract price for uranium concentrates remained at $95 from March 2007 to March 2008 and then declined slowly to $65 per pound by May 2009, where it remained through October 2009. In January 2011, the long-term price indicator reached $70 per pound U_3O_8. Following the accident at Fukushima Daiichi, the term price began a steady decline from $68 per pound U_3O_8 in March 2011, to $45 per pound in March 2014 as shown in Figure 2.1. The term market indicator rose to $50 per pound in November 2014, where it remained through the end of January 2015.

[5] Market price and term market indicators are as reported in TradeTech's Nuclear Market Review. www.uranium.info.



Source: TradeTech

Figure 2.1 Historical Uranium Spot and Term Market Price Indicators

2.1.2 Uranium Requirements

"Requirements" for nuclear fuel, as used herein, refers to the quantity of uranium will be needed to produce nuclear fuel for reactors which are expected to be operating during the forecast period.[6] As noted in Section 2 above, ERI's forecast of requirements are calculated on a plant-by-plant basis, based on fuel discharge burn-up, reload fuel assays, fuel cycle lengths, first-core and reload lead times, and operating capacity factors. Annual "demand" for uranium, which is different than "requirements" as shown in Figure 2.3, includes not only annual "requirements" but also purchase of strategic inventory (as indicated in Figure 2.3). Inventory draw downs, such as expected in Japan due to excess inventories built up following the Fukushima accident, reduce uranium demand.

World requirements for uranium were 160 million pounds in 2014. ERI projects that total World requirements for uranium will be 158 million pounds in 2015. A strong increase

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[6] Reactor operators may buy more or less uranium in a given year than their requirements for that year, depending on their existing inventories and any planned buildup of strategic inventory. In addition, a given reactor could temporarily consume more or less uranium than its expected requirements—for example because of an unplanned outage or better-than-expected operation. ERI's forecast of annual "requirements" is based on expected plant-by-plant cycle lengths, capacity factors, and fuel utilization and does not take account of such temporary fluctuations.

starts in 2016 as uranium requirements return to a pre-Fukushima level of 172 million pounds and average 182 million pounds between 2018 and 2020. Requirements are forecast to rise steadily thereafter, to 203 million pounds in 2025, 233 million pounds in 2030 and to 256 million pounds in 2035. Compared to the uranium requirements forecast in the April 2014 ERI market analysis, there has been a 1.3% decrease in uranium requirements through 2022, or 2.4 million pounds annually. For the period 2027 to 2035, ERI's current forecast of uranium requirements is on average 1.8% higher than the forecast utilized in the April 2014 ERI analysis. During the forecast period, U.S. requirements remain essentially flat, averaging just over 46 million pounds per year between 2015 and 2035.

The reduction in uranium requirements in the near term in ERI's updated forecast is due to the slower pace assumed for the restart of Japanese reactors and an expected reduction in nuclear power installed capacity in France compared to the April 2014 ERI forecast. In Japan, while four units received approval to restart from the Japanese Nuclear Regulatory Authority during 2014, the actual dates for restart have not been set. In addition, it is expected that some older units will not restart and that the need for local government and prefecture approval for restart may complicate the process and timing. The French government is expected to pass legislation that will reduce the contribution of nuclear energy in France to 50% by 2025. ERI's Reference forecast has been updated to reflect this, resulting in a reduced contribution by nuclear power in France between 2020 and 2024. The longer term increase is associated with an improved outlook for the development of nuclear power in Russia, Turkey and a few other nuclear newcomers. This includes a faster pace of new reactor additions in Russian after 2025, construction of a second reactor in Belarus by 2025, construction of additional units in Iran after 2025, Turkey after 2030.

2.1.3 Uranium Supply

Uranium supply includes primary uranium production worldwide and secondary supply sources. Regarding U.S. uranium production, ERI generates projections for uranium production based on individual producer's published production capacities for individual uranium production centers worldwide. U.S. uranium production for 2014 was 4.9 million pounds which is at the low end of the range of 5.0 to 5.7 million pounds estimated in the April 2014 ERI market analysis but still 5% higher than 2013 production. The start up of Peninsula's Lance project has been delayed to 2015 and Ur-Energy and Uranerz slowed the ramp up of production at the Lost Creek and Nichols Ranch projects. In February 2015 Cameco announced its decision to halt new well field development at its Wyoming operations due to market conditions. Total U.S. production in 2015 is now expected to decline back to 2012 levels or slightly lower, even though the Peninsula's Lance ISL project may start up in the second half of the year.

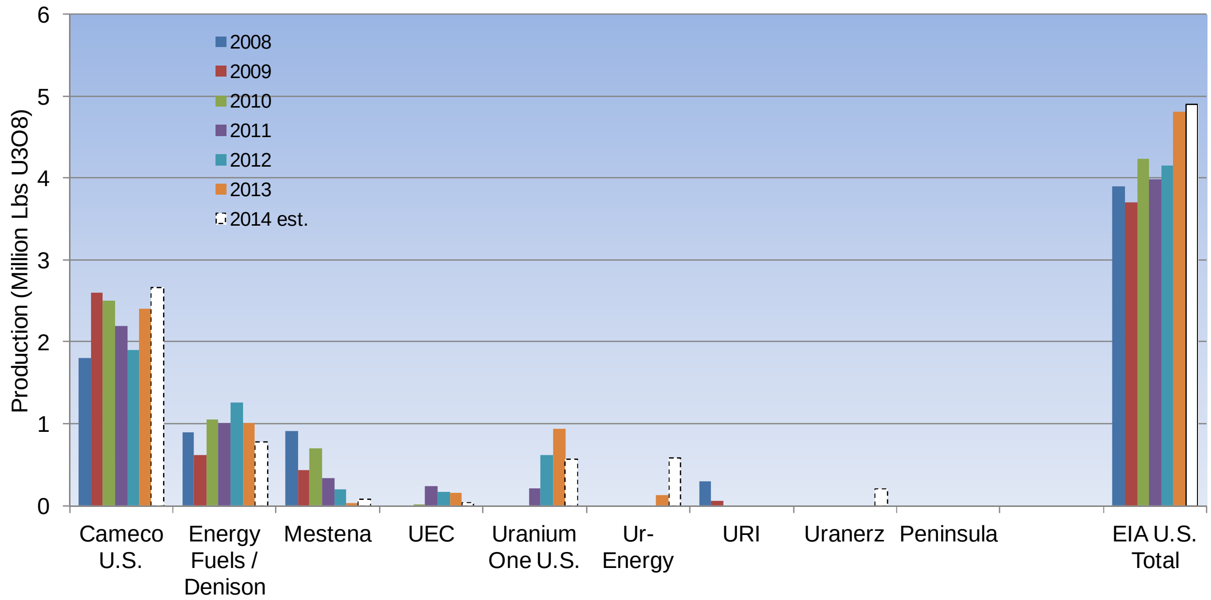

Figure 2.2 U.S. Uranium Production History by Company

2.1.4 Adequacy of Uranium Supply Relative to Requirements

ERI develops its Reference forecast for uranium supply based on published supplier plans for production from existing mines as well as plans for expansion of existing mines and new mines under active development. The initial production schedules for planned and prospective mines are dependent on market conditions and support and therefore are speculative. While optimistic or "earliest possible" initial production schedules are often available, current projections indicate an average delay of eight years as consistent with actual market need for new planned and prospective mines. ERI also assumes that on average mine production will be at 90% of nominal capacity over the long term due to production interruptions from unforeseen events such as accidents, floods, equipment failures, etc. As used here, uranium "supply" includes both primary production and secondary supply. Primary production refers to the amount of uranium actually produced, which may or may not represent the full or available capacity of a given mine. Secondary supply sources include: commercial inventories that may enter the market; government excess inventories, such as the DOE material that is the subject of this report and excess Russian inventories; material from Russian tails recovery; enricher underfeeding, and plutonium and uranium recycle. Ideally available supply will be somewhat greater than demand, which consists of reactor requirements for immediate consumption plus strategic inventory building needs. When actual production causes supply to exceed demand, excess inventories are created. Based on ERI's November 2014 Reference forecast for uranium supply adequacy through 2035, Figure 2.3 presents the projected world uranium supply and requirements relationship using the updated ERI Reference requirements and accounting for recent developments, discussed below, on the primary supply side. The figure includes existing mine supply including expansions and supply from mines under active development, but potential supply from planned and prospective mines is excluded.[7]

Regarding recent developments in uranium supply, primary production of uranium has decreased on a world basis through the first nine months of 2014. While not all suppliers report production on a quarterly basis, announcements have been made by suppliers responsible for 79% of 2013 total production. Production by these suppliers has declined by 15% during the first nine months of 2014. World uranium production for 2014 is projected to be 147 million pounds, which represents a 7 million pound or 4.6% decrease from production in 2013.

The decrease in primary production is the result of announced production cutbacks and delays of expansion plans and additional announcements are likely to be forthcoming. The cutbacks and delays are in response to the reduction in uranium requirements in the near term. Even with these production cutbacks and delays, as shown in Figure 2.3, significant oversupply exists through the year 2022 if all current mine expansions and mines under development proceed according to schedule.

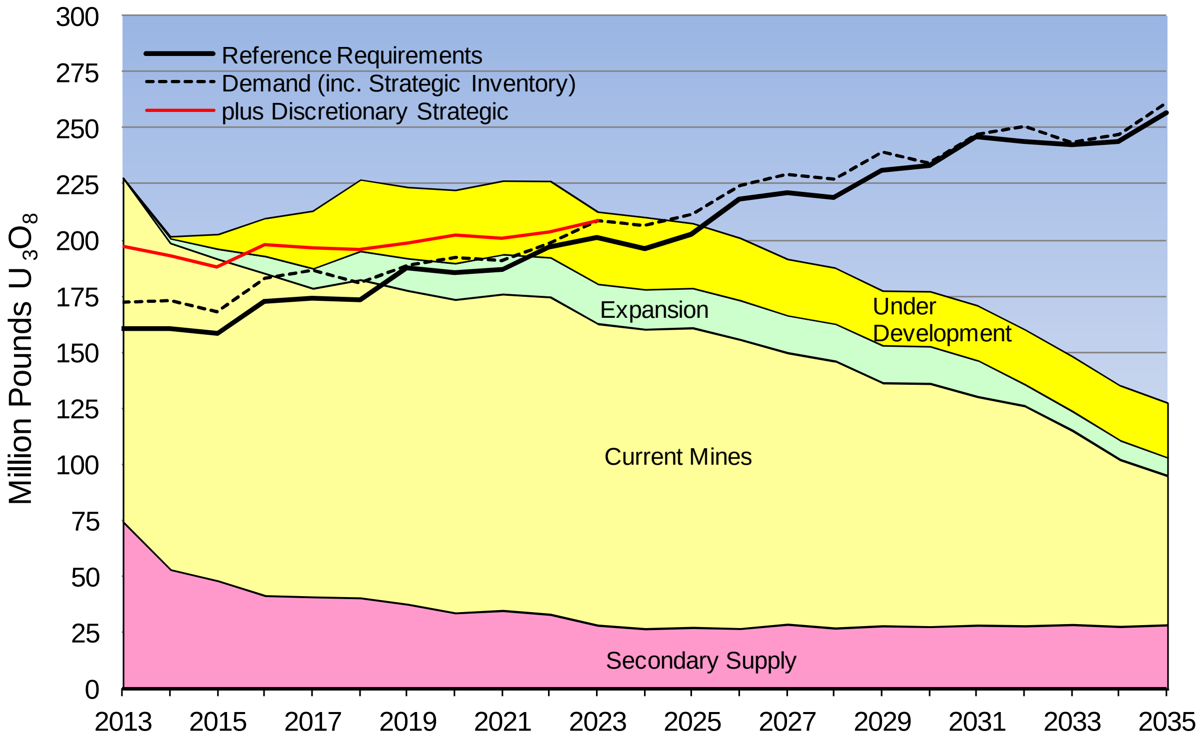

Figure 2.3 Supply Adequacy Assuming Scheduled Supply and Reference Requirements

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[7] We regard a mine as being in “active development,” not just planned, when the property is undergoing active development (permitting, construction, preparation for operations). ERI views mines under development as having a high probability that production of uranium will occur during the forecast period.

More than half of the secondary supply shown in Figure 2.3, in 2015 and 2016, originates directly or indirectly from tails material: Russian tails recovery (26%); underfeeding of Russian enrichment plants (19%); Western enricher underfeeding (11%). Other secondary supply sources include DOE transfers affecting the market (17%); plutonium and uranium recycle (14%); commercial inventories (10%) and Russian HEU (3%).

As shown by the dashed line in the figure labeled "Demand (inc. Strategic Inventory)", actual demand for uranium will be greater than nuclear power plant requirements, as end-users normally increase the amount of uranium held in strategic inventory as new units are brought on line and uranium requirements increase. Some offsets can occur by end-users reducing strategic inventory levels as plants are retired (or to make use of excess inventory accumulated during the reactor outages in Japan). China has been purchasing large amounts of uranium well in excess of the two years of forward requirements typical for other end users. This additional demand is captured by the red line labeled "plus Discretionary Strategic" in Figure 2.3. The discretionary strategic inventory building by China has averaged 20 million pounds per year since 2010. ERI projects that these purchases will continue at their current rate in the near term, consistent with China's actions over the past several years. However, in order to not overstate demand in the long-term, ERI conservatively assumes that discretionary strategic inventory building by China will taper off by 2023.

Figure 2.3 makes it clear that supply from existing mines, from expansions and from mines under development as currently scheduled needs to be adjusted downward if significant over supply is to be avoided over the next eight years. In the longer term new production will be needed from planned and prospective mines. Figure 2.4 presents the projected world uranium supply and requirements relationship for ERI's Reference Supply and Reference Nuclear Power Requirements forecast when all supply sources are included by adding planned and prospective mines; however under this projected uranium supply scenario, some adjustments are made with respect to how quickly mines under development, planned mines, and prospective mines come online. In addition, the forecast assumes that mines under development will ramp up to full capacity at a slower rate than originally planned. This scenario represents ERI's best estimate of the long-term relationship between uranium supply and demand. As observed in Figure 2.3, output from mines under development could cause total supply to exceed demand (reactor requirement plus expected changes in end-user inventories) through the year 2022. Production from mines under development is dominated by two large projects – Cigar Lake in Canada and Husab in Namibia. Based on this supply adequacy analysis, output from planned mines is not needed until 2023 and will not be a major contributor until after 2025. First output from prospective mines is not needed until the year 2025 but then must grow rapidly, averaging 33 million pounds per year between 2026 and 2030.

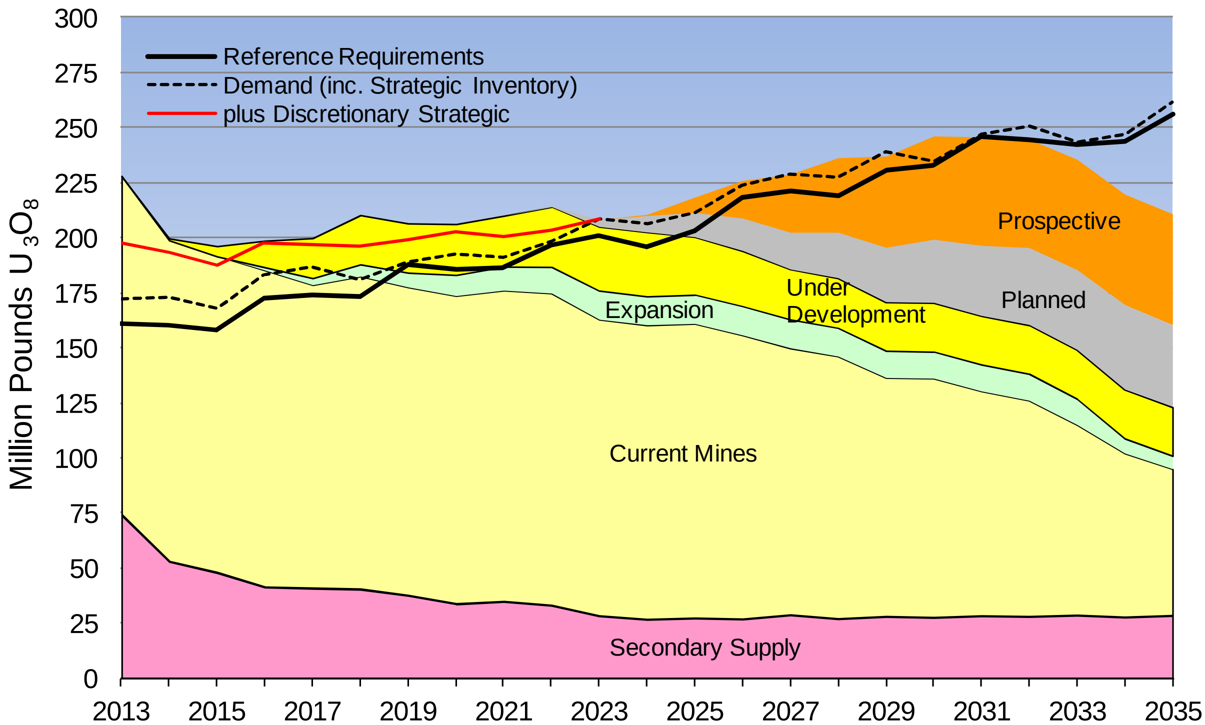


Figure 2.4 Supply Adequacy Assuming Delayed Supply and Reference Requirements

Total mine production for 2014 is projected to be 147 million pounds, which represents a 7 million pound or 4.6% decrease from production in 2013. Increases are then likely, to 150 million pounds in 2015, an average of 160 million pounds in 2016-2017, 174 million pounds per year in 2018-2021 and an average of 183 million pounds annually in 2021-2025. Output from currently existing mines will decline to 135 million pounds by 2025 and 108 million pounds by 2030. Supply from secondary sources is projected to remain a significant but gradually decreasing contributor, driven mostly by enrichment of tails and underfeeding during the enrichment process. While secondary supply decreases as a percentage of total uranium supply (due to the increase in primary supply) as shown in Figure 2.3 and 2.4, secondary supply is projected to be flat from 2023 through 2035. From 2023 forward, secondary supply will include DOE inventory (20%), Russian and western enricher underfeeding (52%) and plutonium and uranium recycle (28%).

2.2 Conversion Services

2.2.1 Conversion Market Price Activity

Figure 2.5 provides North American conversion market price indicators from 2008 to the present. Over the past ten years, the spot market for conversion services has been highly volatile, marked by rapid increases and severe declines. As a result of the closure of Metropolis Works in 2012, the North American spot market price for conversion services reported by TradeTech rose from $6.75 per KgU in June 2012, to a high of $10.50 per kgU by October 2012. With the announced restart of the plant in June 2013, the North American spot market price began to fall reaching $9.25 by July 2013. The price fell to $7.50 per kgU in May 2014, rising to its present level of $8.50 in December 2014.

The North American long-term market price has historically been much less volatile. The reported term price remained in a tight range of $11.00 to $12.25 per kgU from January 2005 through mid-2010. The term price then steadily increased over the following year, reaching $16.75 in September 2011, where it has remained until July 2013, when it fell to $16.00 per kgU, where it remains today. The 46% increase in term price in mid-2011 followed an October 2010 announcement by Converdyn regarding its pricing in future contracts. As shown in Figure 2.5, the term market indicator is unchanged from the beginning of 2014, while the spot market indicator declined in mid-2014 but then recovered for an overall increase of 13% since April 2014.

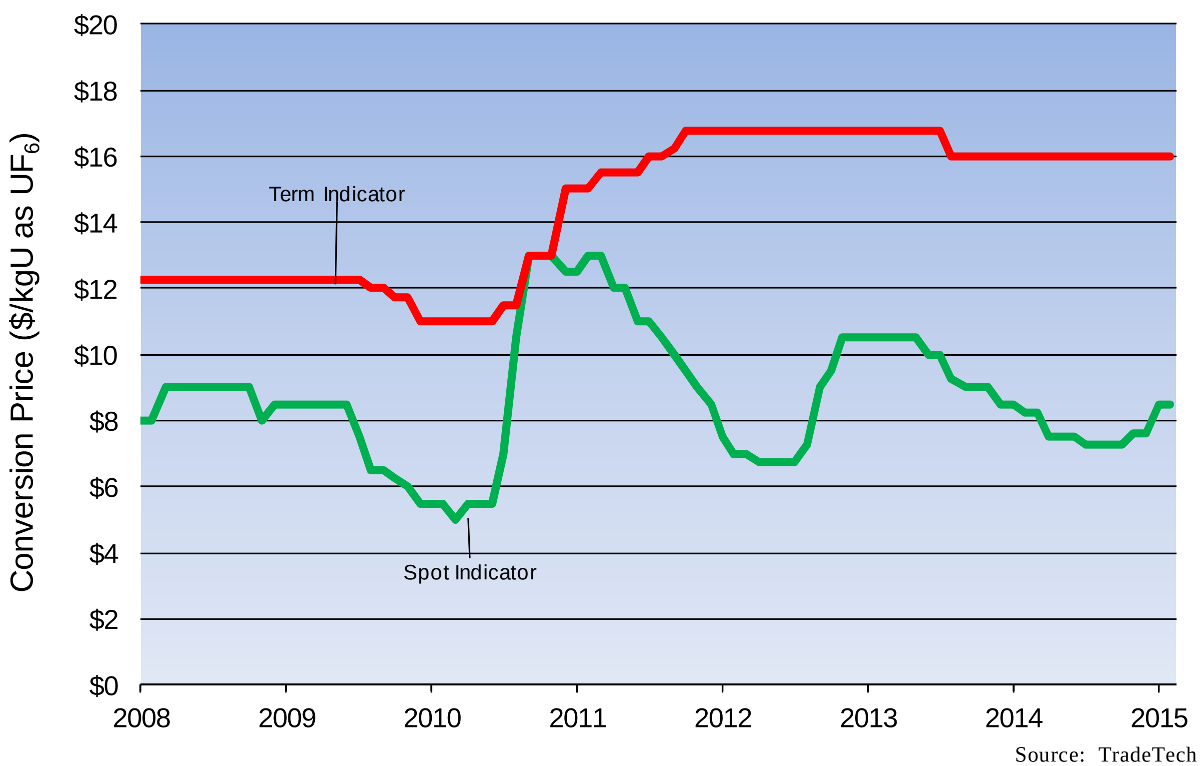


Figure 2.5 Historical North American Market Indicators for Conversion Services

2.2.2 Conversion Services Requirements

ERI's Reference forecast of requirements for conversion services are calculated on a plant-by-plant basis, based on fuel discharge burn-up, reload fuel assays, fuel cycle lengths, first-core and reload lead times, and operating capacity factors. Annual projected requirements for uranium as UF_6 for ERI's November 2014 Reference forecast world requirements are projected to rise gradually from 54.4 million kgU in 2014 to 55.9 million in 2015, to 67.2 million kgU by 2020 and to 91.4 million kgU by 2035. ERI projects that U.S. requirements for conversion services will remain essentially unchanged from 2014 through 2035 and to average 17.6 million kgU.

2.2.3 Adequacy of Conversion Supply Relative to Requirements

Figure 2.6 provides an updated requirements and supply forecast for conversion services as UF_6 in order to provide an updated supply adequacy examination. Conversion supply includes primary production of UF_6 and secondary supply sources. Assumptions regarding annual production of UF_6 are based on information from producer annual reports, data from other industry sources, and ERI analyses of the conversion market. As discussion in Section 2.4.1, China has imported large quantities of U_3O_8 (not natural UF_6) in order to build its strategic inventory during the past five years. If China does not grow its indigenous UF_6 production capacity, it will have to re-export the U_3O_8 for conversion, and again import the UF_6 – a scenario that seems unlikely. This is consistent with expected Chinese policy of self-sufficiency and ERI assumes that China will continue to expand its indigenous conversion production capacity in order to meet growing Chinese requirements. While AREVA's Comurhex II can be expanded further, AREVA has stated that it will not expand capacity beyond 15 million kgU per year unless warranted by market conditions. As such, ERI assumes that Comurhex II capacity remains at 15 million kgU per year through 2035. New supply from the planned expansion of Rosatom's Siberian Chemical Combine center is assumed to come on line in 2019 and Rosatom's Angarsk plant was closed in 2014. Within the secondary supply component shown in Figure 2.6, in 2015 and 2016, the largest component of secondary supply is uranium from Russian tails recovery (28%); underfeeding of Russian enrichment plants (20%); DOE inventory entering the market (18%); plutonium and uranium recycle (15%); Western enricher underfeeding (11%); commercial inventories (5%) and Russian HEU (3%). As indicated by Figure 2.6, total expected world conversion supply exceeds projected requirements for conversion services beyond the year 2025. The supply excess averages over 6 million kgU as UF_6 annually over the next ten years (2015-2024) and is equivalent to 9.5% of requirements. Available supply exceeded requirements by an average of 11 million kgU as UF_6 annually over the last two years (2013-2014).

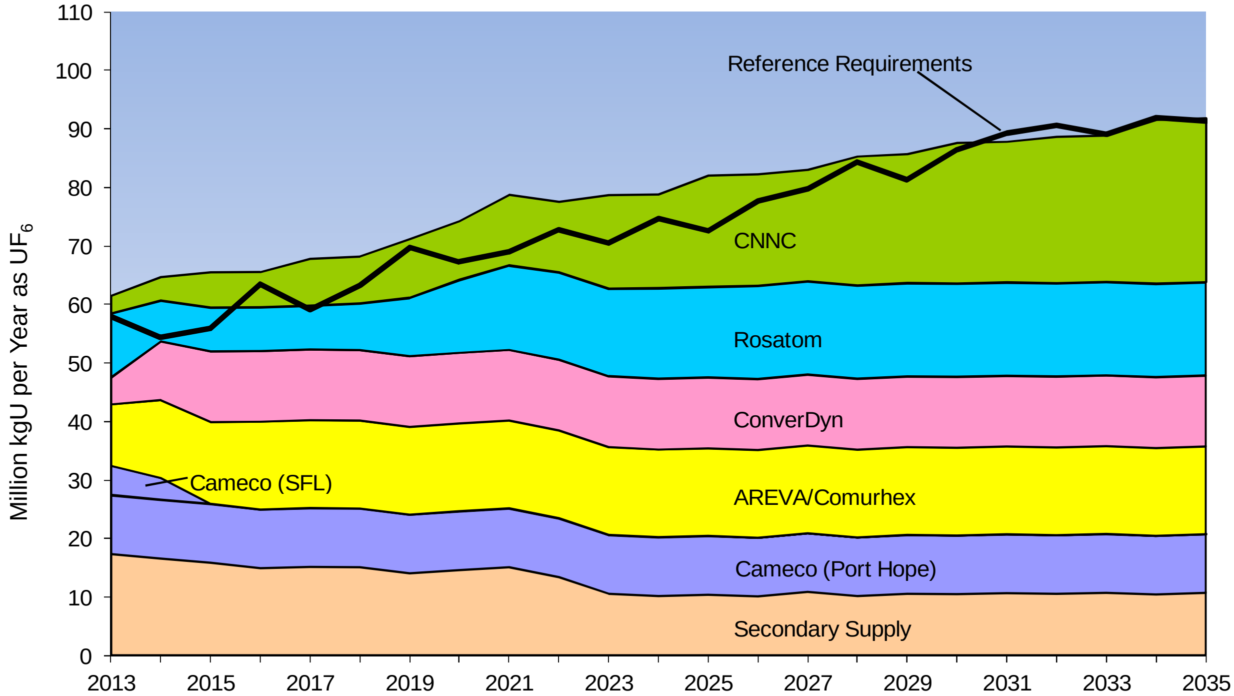


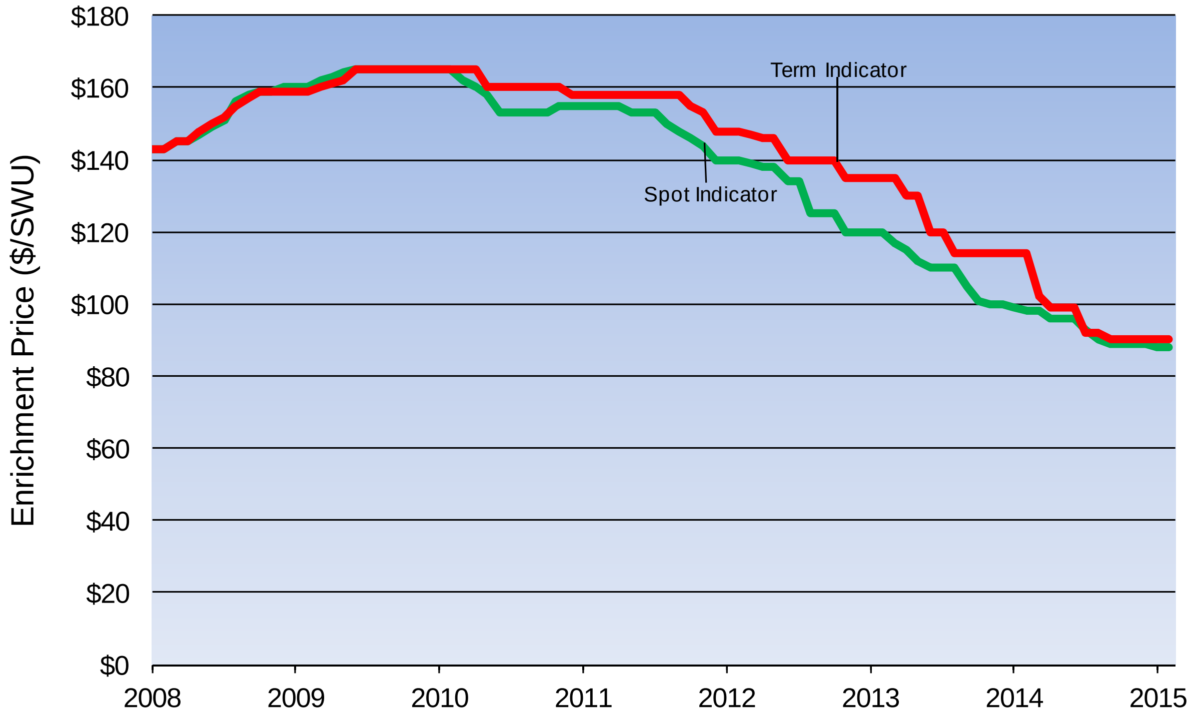
Figure 2.6 Forecast of World Supply and Requirements for Conversion Services

2.3 Enrichment Services

2.3.1 Enrichment Market Price Activity

As shown in Figure 2.7, the long-term price indicator for enrichment services, as reported by TradeTech, reached a high of $165 per separative work unit (SWU) in May 2009. However, by early 2010 the price began a steady decline, reaching $135 per SWU in October 2012, and further declining during 2013 to the present price of $90 per SWU in August 2014. While more than 90% of enrichment requirements are covered under long-term contracts, enrichment services and EUP are also traded on the spot market although in lower volumes than uranium. Enrichment spot market indicators, rose to a high of $165 per SWU in May 2009, but began a slow decline similar to that for the long-term SWU price indicator as shown in Figure 2.7. The spot market indicator declined to $88 per SWU as of January 31, 2015.

Figure 2.7 provides enrichment market price indicators updated to include activity between March 31, 2014 and January 31, 2015. Both the spot and term market indicators declined in the four to five months following the April 2014 ERI market analysis, but have not changed since August 2014. The term market indicator is $9/SWU (9%) lower and the spot market indicator is $8/SWU (8%) lower when compared to the end of March values.



Source: TradeTech

Figure 2.7 Historical Spot and Long-Term SWU Market Price Indicators

2.3.2 Enrichment Services Requirements

ERI's Reference forecast of requirements for enrichment services are calculated on a plant-by-plant basis, based on fuel discharge burn-up, reload fuel assays, fuel cycle lengths, first-core and reload lead times, and operating capacity factors. "Requirements" for enrichment services, as used herein, refers to the quantity of enrichment services that will be needed to produce nuclear fuel for reactors which are expected to be operating during the forecast period. ERI's November 2014 Reference forecast for enrichment services requirements projects that annual world requirements for enrichment services in 2014 are 40.2 million separative work units (SWU), but should then increase 11% to nearly 45 million SWU in 2015, still below pre-Fukushima levels. Requirements are forecast to average 52 million SWU per year between 2016 and 2020, 59 million SWU per year between 2021 and 2025, 67 million SWU per year between 2026 and 2030, and 74 million SWU per year between 2031 and 2035. U.S. requirements are projected to be essentially flat, averaging almost 15 million SWU per year between 2015 and 2035.

2.3.3 Adequacy of Enrichment Supply Relative to Requirements

Figure 2.8 provides an updated requirements and supply forecast in order to provide an updated supply adequacy examination. Enrichment services supply includes primary production of EUP and secondary supply sources. Assumptions regarding annual production of EUP are based on information from producer annual reports, data from other industry sources, and ERI analyses of the enrichment market. For Western enrichers, only existing capacity and firmly planned[8] new capacity are assumed and the supply shown is for all enrichment capacity, prior to any redirection for uranium production via underfeeding and refeeding of existing tails stockpiles.

As indicated by Figure 2.8, total expected world enrichment supply significantly exceeds projected requirements for enrichment services by a significant margin over the long term. However, it is expected that enrichers will continue to redirect enrichment capacity to underfeeding and that Rosatom will likely continue to re-enrich existing uranium tails. The long-term supply adequacy shown in Figure 2.8 includes the assumption that Urenco will replace cascades at the European sites as they retire after 25 years of operation, keeping installed capacity constant. However, during 2013 Urenco retired a total of 0.3 million SWU at its European sites - approximately 2% of its European capacity. Any decisions to retire additional capacity will be made on the basis of contract commitments and the operational costs of older cascades. It is noted that Urenco cascades reaching 25 years of age will only average about 0.2 million SWU per year over the next ten years.

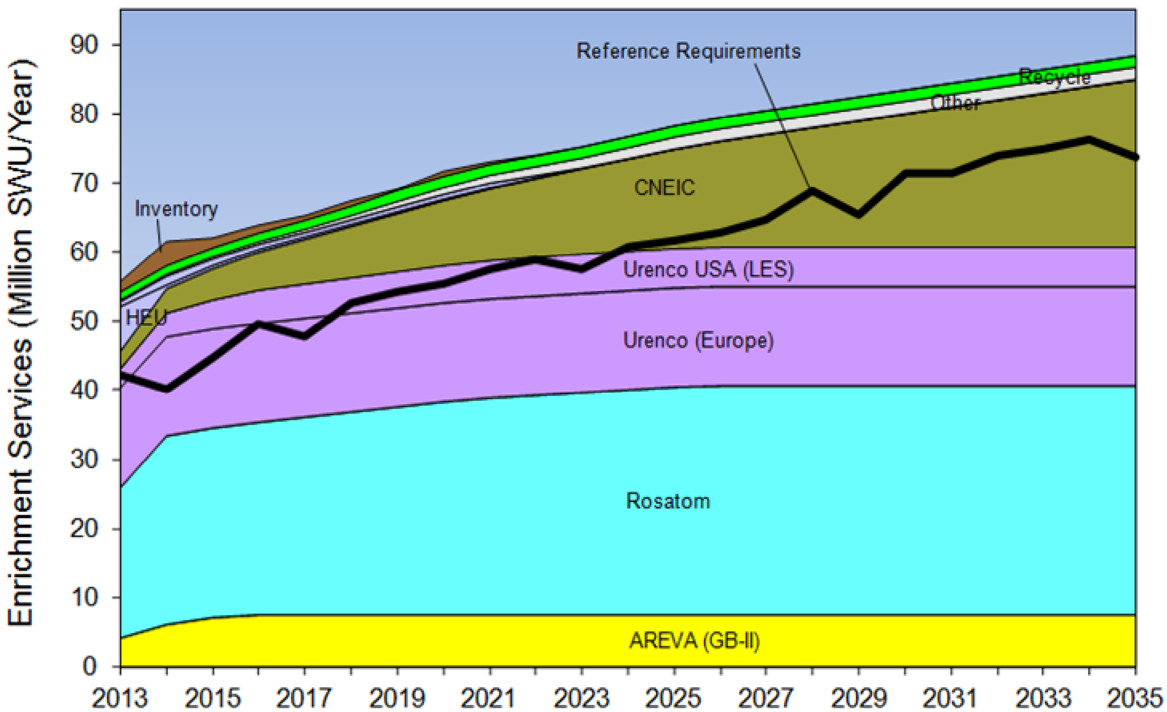


Figure 2.8 Forecast of World Supply and Requirements for Enrichment Services

[8] Firmly planned new capacity refers to enrichment facility capacity additions which have been announced by primary producers.

2.4 Summary of U.S. Requirements for Nuclear Fuel

Figure 2.9 provides a summary of U.S. requirements for nuclear fuel materials and services over the period 2014 through 2035 that is based upon ERI's current Reference Nuclear Power Growth forecasts. ERI's Reference forecast of requirements for nuclear fuel materials and services are calculated on a plant-by-plant basis, based on fuel discharge burn-up, reload fuel assays, fuel cycle lengths, first-core and reload lead times, and operating capacity factors The saw tooth nature of these annual requirements reflects that nearly all U.S. nuclear power plants operate on 18 or 24 month refueling cycles.

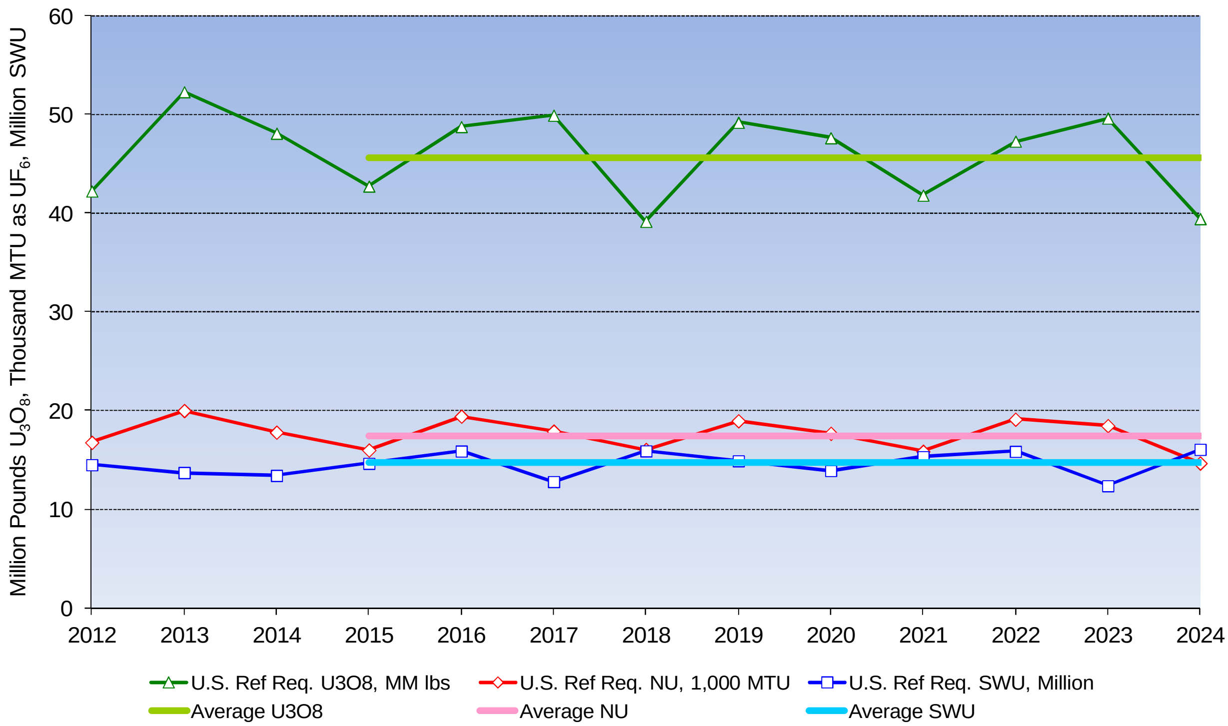


Figure 2.9 U.S. Requirements for Nuclear Fuel Materials and Services

Since the underlying change in average U.S. requirements over time is relatively small, but with significant year-to-year variation, average values that represent forecast years 2015 through 2024 are presented in Table 2.1. These values may be used to provide perspective regarding the quantities of DOE material released to the global commercial markets relative to U.S. requirements.

	Average Over Period 2015 - 2024	Average Used in April 2014 Analysis 2014 - 2024
U.S. Uranium Concentrates Requirements Million Pounds U_3O_8	45.6	48.2
U.S. Uranium Conversion Requirements Million MTU of U as UF_6	17.4	18.8
U.S. Enrichment Services Requirements Million SWU	14.8	15.1

Note: 1,000 MTU = 1 million kgU
Source: ERI 2014 Nuclear Fuel Cycle Supply and Price Report, Update, Reference Nuclear Power Growth Forecast, November 2014

Table 2.1 Summary of U.S. Requirements for Nuclear Fuel Materials and Services

The updated projections for average U.S. requirements are lower than those used in the April 2014 ERI market analysis. Projected U.S. uranium requirements have declined by 5%, U.S. conversion requirements by 7% and U.S. enrichment requirements by 2%. The percent change in uranium, conversion and enrichment requirements differ due to a variety of factors, including the fact that nuclear fuel assemblies may contain natural uranium pellets, such that some uranium does not require enrichment; the feed material for these natural uranium pellets may also be made from UO_2, which did not undergo conversion from U_3O_8 to UF_6; and the enrichment tails assay will also impact the amount of natural uranium and enrichment requirements. ERI's projection of U.S. requirements assumes additional delays in the start of new reactors that are under construction and additional reactor retirements due to economic pressures. Economic pressures that impact decisions regarding continued nuclear plant operation, as reflected in ERI's lower projection of U.S. requirements, include low natural gas prices, the completion of higher-priced power purchase agreements, competition from subsidized renewables and low value placed on base-load capacity in deregulated markets. ERI expects an additional five retirements totaling 4 GWe to take place in the U.S. by 2017. No additional new build is expected to occur in the U.S. until after 2025 in the Reference projection.

As a point of comparison, the ERI requirements forecasts shown in Table 2.1 are more conservative than the most recent analysis by the World Nuclear Association (WNA), which was published in September 2013 and is entitled "The Global Nuclear Fuel Market: Supply and Demand 2013-2030" (WNA 2013). Over the 2015 through 2024 period, the total U.S. nuclear fuel requirements forecasts published by WNA are approximately 10% higher than those shown in Table 2.1. The 2013 WNA projection of world requirements is about 11% higher than the ERI requirements forecasts over the next ten years. In general, the WNA projection is based on more optimistic assumptions regarding new capacity additions and early retirements in both the U.S. and the world as well the restart schedule for reactors in Japan.

2.5 Summary of Published Market Prices

Current monthly spot and term market prices[9] (also referred to as "price indicators") are summarized in Table 2.2. The current market prices for uranium concentrates and uranium as natural UF_6 are 10% to 11% higher than the then-current prices used in the April 2014 ERI market analysis. Conversion services spot market prices are 13% higher and long-term prices are unchanged, while the prices for enrichment services are 8% to 9% lower.

	Spot Market Price	Long-Term Market Price
Uranium Concentrates $/lb U_3O_8	$37.25	$50.00
Uranium Conversion Services (North American) $/kgU as UF_6	$8.5	$16.00
Enrichment Services $/SWU	$88.00	$90.00
Uranium as Natural UF_6 $/kgU as UF_6	$105.25	$147.00

Market Price Indicators are as published by TradeTech in the January 31, 2015 issues of its weekly publication, Nuclear Market Review. http://www.uranium.info

Table 2.2 Recently Published Market Prices

Despite some gains during the second half of 2014, market prices have declined considerably since the Fukushima event three and a half years ago. Uranium, conversion and enrichment spot price indicators have all demonstrated similar declines, with prices as of January 31, 2015 ranging between 35% and 44% lower than prices on February 28, 2011 just prior to the Fukushima event. For the term markets, enrichment prices are down 43%

[9] TradeTech's spot prices "reflect the company's judgment of the price at which spot and near-term transactions for significant quantities [of that product or service] could be concluded as of the last day of the month". TradeTech's long-term price indicators are "TradeTech's judgment of the base price at which transactions for long-term delivery of that product or service could be concluded as of the last day of the month, for transaction in which the price at the time of delivery would be an escalation of the base price from a previous point in time." While ERI utilizes price indicators published by TradeTech in this report, it should be noted that fuel supply contracts that have market related pricing generally reference the TradeTech price indicators as well as price indicators published by Ux Consulting (www.uxc.com). While the indices published by these companies are not identical at all times they do closely track one another. For example, over the period January 2012 through November 2014 the uranium, conversion and enrichment spot and term indicators have differed by an average of ±0.6% or less with one exception -the Ux spot indicator for North American conversion services has averaged 4.5% higher than TradeTech. Both provide a reliable measure of the spot and term market prices and are widely quoted. Price indicators published by other companies are not as widely used.

mirroring the spot price behavior. Uranium term prices are down 29%, a little less drastic reduction than observed for the uranium spot price. Conversion term prices are the exception and are actually 3% higher than on February 28, 2011.

3. DOE Inventory Expected to Affect the Commercial Markets

As was described in the April 2014 ERI market analysis, there are three broad categories of material for which DOE inventory is expected to affect the commercial markets during the period of time that is addressed by this analysis (2015 through 2024). They are (i) historical DOE transfers, the natural and enriched uranium from which will continue to displace commercial supply in the market in the future, (ii) planned inventory transfers in exchange for services (barters), for which DOE is specifically assessing whether a determination under § 3112(d) would be sound, and (iii) proposed transfers of DOE inventory, including additional DUF_6, off-spec LEU, and a limited amount of off-spec non-UF_6 that are currently under negotiation with selected companies, as a result of earlier DOE RFOs. As reflected below, DOE has asked ERI to assess quantities somewhat different from those used in the April 2014 ERI market analysis.

3.1 Historical DOE Transfers Resulting in Natural and Enriched Uranium Which Continue to Displace Commercial Supply

DOE has transferred inventories in the past, and the resulting natural and enriched uranium will continue to displace commercial supply in the market in the future, even though the transfers are completed. The historical transfers include off-spec HEU to the TVA and high assay DUF_6 to ENW. In each case, the transferred DOE inventories were to be processed (down blended or re-enriched) and the resulting LEU product loaded into reactors over a period of many years. For purposes of evaluating the effect of the transferred inventories on the commercial markets and U.S. industry, the time at which DOE transferred the material to a recipient is not necessarily the most important fact. It is appropriate to evaluate the effect according to the schedule of the delivery of the processed inventory as reactor fuel, consistent with the times at which commercial supply would otherwise be used to fulfill the reactor fuel requirements.

Off-Spec HEU to TVA

TVA has been blending off-spec HEU from the NNSA since 2005 under the BLEU program.[10] A total of 46 metric tons (MT) of HEU has been processed. The transfer to and down blending of the off-spec LEU by TVA's down blending contractors was completed in 2012. The first BLEU reload was introduced into a TVA reactor in 2005. BLEU reloads continue to be loaded into the Browns Ferry reactors. At the time of the April 2014 ERI market analysis the final BLEU reload was scheduled for 2016. The NNSA has extended the BLEU program by down blending an additional small quantity of off-spec HEU. The natural uranium equivalent of the additional new BLEU material is expected to average 53

[10] This is a long-term contract between DOE and TVA under which the first fuel assemblies that contained the NNSA off-spec material were loaded into a TVA nuclear power plant in March 2005.

MTU as UF_6 annually between 2017 and 2023. The equivalent uranium concentrates and enrichment services will average 140,000 lbs-U_3O_8 and 60,000 SWU per year.[11]

ERI believes that any potential uranium or conversion market effect of the DOE transfers to TVA would be most appropriately viewed as occurring during the year prior to such materials being loaded in the TVA nuclear power plants. This is consistent with a 12 month lead time prior to the start of a refueling outage for the delivery of uranium concentrates and conversion services. The displacement of commercial supply in the market associated with the enrichment services component of the BLEU reloads is assumed to take place 6 months prior to the refueling outage.

DOE Depleted UF_6 Transferred to ENW and Subsequent ENW LEU Sale to TVA

DOE transferred 9,075[12] MTU of high assay DUF_6 to ENW in 2012 and early 2013. The DUF_6 was then enriched to LEU by ENW, with enrichment services provided under a contract with USEC. The enrichment took place between June 2012 and May 2013 at the Paducah GDP. ENW entered into a contract with TVA for the purchase by TVA of most of the enrichment services content contained within the LEU as well as a significant portion of the natural uranium content. The enrichment services and natural uranium equivalent are to be delivered to and used by TVA between 2015 and 2022. ENW will use its share of the natural uranium content between 2021 and 2029 to meet reload requirements for the Columbia Generating Station.[13] As indicated by the above discussion, while the DUF_6 was transferred to ENW in 2012, the natural uranium and enrichment contents of the resulting LEU do not displace commercial supply in the market until the 2015 to 2029 time frame when they are actually used by TVA and ENW. The natural uranium and enrichment services content of the LEU created from the DUF_6 are being delivered under long-term contract arrangements.

[11] For the purposes of this analysis, these future off-spec HEU transfers are included in the same category as the material in the historical BLEU program. Both the historical and future transfers are conducted under Section 3112(e) of the USEC Privatization Act which covers transfers to federal, state, and local agencies; nonprofit, charitable, or educational institutions; and others. Thus, while not covered by the Secretarial Determination required under Section 3112(d), DOE requested their inclusion in this analysis to inform the DOE's overall decision making regarding uranium transfers.

[12] DOE's July 2013 Excess Uranium Inventory Management Plan indicates 9,082 MTU of high assay DUF_6 while ENW's Fuel Management Plan specifies 9,075 MTU. ENW delivered 600 MTU of natural UF_6 to USEC along with the DUF_6.

[13] Quantities and scheduled use of natural UF_6 and enrichment services confirmed by private communications with ENW and are different from those assumed in April 2014 ERI market analysis.

Summary of Historical DOE Transfers Resulting in Natural and Enriched Uranium Which Continue to Displace Commercial Supply

Table 3.1 presents a summary of the year and quantities of natural uranium as UF_6, equivalent uranium concentrates, and enrichment services from historical DOE transfers that will continue to affect the commercial markets. Totals are provided for the period 2015 to 2024 covered by this analysis. Quantities affecting the markets in 2012 through 2014 are also shown to provide additional perspective.

Note that a total of 4.4 million SWU were contracted with USEC to enrich the DUF_6 to commercial LEU between June 2012 and May 2013, allowing USEC's Paducah enrichment plant to remain open for one extra year. However the 4.4 million SWU has not been considered as increasing demand when analyzing the effect of DOE inventory releases on the enrichment market in 2012-2013 and therefore an offset is not shown in Table 3.1. The new demand created was effectively balanced by the new supply created (one year extension of Paducah GDP), resulting in no net impact to the enrichment market. The arrangement was of course beneficial to domestic enrichment company USEC in 2012 and 2013.

Year	MTU as UF_6			Equivalent Million Pounds of U_3O_8 (a)			Equivalent SWU (Millions)		
	TVA BLEU	ENW DUF_6	Total	TVA BLEU	ENW DUF_6	Total	TVA BLEU	ENW DUF_6	Total
2012	318		318	0.8		0.8	0.7		0.7
2013	627		627	1.6		1.6	0.3		0.3
2014	318		318	0.8		0.8	0.7		0.7
2015	318		318	0.8		0.8	0.3	0.4	0.8
2016	105		105	0.3		0.3	0.1	0.2	0.3
2017	28		28	0.1		0.1	0.0	0.2	0.2
2018	28	625	653	0.1	1.6	1.7	0.0	0.5	0.5
2019	56	1,050	1,106	0.1	2.7	2.9	0.1	0.5	0.5
2020	93		93	0.2		0.2	0.1	0.4	0.5
2021	74	250	324	0.2	0.7	0.8	0.1	0.5	0.6
2022	56		56	0.1		0.1	0.1	0.4	0.4
2023	37	450	487	0.1	1.2	1.3	0.0	0.3	0.4
2024									
Total 2015-24	795	2,375	3,170	2.1	6.2	8.3	0.8	3.2	4.1

(a) Calculated by multiplying the MTU as UF6 value by a conversion factor of 0.00261285.

Table 3.1 Historical Transfers That Continue to Displace Commercial Supply

3.2 Planned DOE Inventory Transfers Subject to § 3112(d)

NNSA Barters

In recent years, the down blending of DOE HEU has been performed by a NNSA contractor, which received a portion of the 4.95 w/o LEU created from the HEU down blending as barter in lieu of payment for its services. This material received by the NNSA contractor was then sold on the commercial markets. NNSA is now contemplating a down blending program that would run through the year 2024, rather than the year 2022 as was expected at the time of the April 2014 ERI market analysis. DOE asked ERI to assess the market effects of such a program assuming several scenarios, with the amount of bartered LEU containing up to 650 MTU of natural uranium equivalent and representing up to 680,000 SWU per year.

Environmental Management (EM) Barters

DOE's Office of Environmental Management (EM) makes quarterly transfers of natural UF_6 to its contractor, Fluor B&W Portsmouth (FBP), for services being provided in support of the environmental cleanup of the Portsmouth GDP. The material received by FBP subsequently enters the commercial markets, via a separate agreement with Traxys North America LLC (Traxys). DOE asked ERI to assess the market effects of this program assuming several scenarios, with the amount of bartered uranium ranging up to 2,055 MTU per year.

Traxys has introduced the EM barter material into the commercial markets partly through spot market and partly through term market transactions.[14] For uranium, Traxys seeks to sell at least 50% of its material on term contracts and at least 50% to non-U.S. customers. For conversion services, Traxys reported that it sold on non-U.S. markets 58% of what EM supplied in 2013, and sold 68% of what EM supplied in 2013 under term contracts. Traxys also reported that 90% of the conversion services to be supplied by EM in 2015 and 2016 (based on a total of 2,055 MTU per year supplied by EM) have already been committed under term contracts.[15] Since there is no guarantee that this same percentage of sales of EM Barter material will be made in later years, in this analysis, ERI conservatively assumes that 50% of the conversion component of the EM barter material is sold on the spot market and 50% is sold under term contracts in 2015 and beyond, consistent with the Traxys goal.

Total EM and NNSA Barters

DOE plans to limit the total natural uranium (NU) equivalent in the EM and NNSA barters to at most 2,705 MTU per year. If the NNSA barters required to pay for the HEU down blending services are less than 650 MTU, then a greater quantity of EM barters could take place, keeping the combined total at the specified limit. If this occurs, the EM inventory of NU would be depleted more rapidly, resulting in a lower quantity in the final transfer year.

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[14] Smith, Kevin, Director Uranium Trading and Marketing, Traxys, Commercial View of DOE's 2013 Plan for Natural Uranium Barter Sales, Nuclear Energy Institute, International Uranium Fuel Seminar, October 6-9, 2013, San Antonio, Texas.

[15] Smith, Kevin P., Traxys North America LLC, Managing Director for Uranium Marketing and Trading, Declaration of Kevin P. Smith, Attachment 6 to Defendant's Opposition to Plaintiff's Motion for Preliminary Injunction, Case No. 1:14-cv-1012-RBW, Document 17-7, Filed July 7, 2014, at 23.

The EM and NNSA barter plans described above are generally consistent with the volumes and schedules used in the April 2014 ERI market analysis. The one difference is the possibility of extending the NNSA barters from HEU down blending by two additional years. DOE has requested that a total of three release scenarios be analyzed:

> Scenario 1: EM release rate of 2,055 MTU per year until 2019 when UF_6 supplies are exhausted and NNSA rate of 650 MTU per year through 2024.
>
> Scenario 2: EM release rate of 1,410 MTU per year until 2021 when UF_6 supplies are exhausted and NNSA rate of 445 MTU per year through 2024.
>
> Scenario 3: No EM or NNSA releases between 2015 and 2024.

The material transfers to DOE contractors as payment for services which are presently under consideration by DOE are summarized in Tables 3.2, 3.3 and 3.4 for each of the scenarios. In addition to showing the annual and total equivalent net amounts of uranium as natural UF_6, which is also the quantity of equivalent conversion services, the corresponding equivalent net amount of uranium concentrates is shown, as is the net equivalent amount of enrichment services.[16] Totals are provided for the period 2015 to 2024 covered by this analysis. Quantities affecting the markets in 2012 through 2014 are also shown to provide additional perspective.

Year	MTU as UF_6			Equivalent Million Pounds of U_3O_8 (a)			SWU (Millions) (b)
	EM Barters	NNSA Barters	Total	EM Barters	NNSA Barters	Total	NNSA Barters
2012	1,601	176	1,777	4.2	0.5	4.6	0.3
2013	2,400	452	2,852	6.3	1.2	7.5	0.5
2014	2,055	650	2,705	5.4	1.7	7.1	0.7
2015	2,055	650	2,705	5.4	1.7	7.1	0.7
2016	2,055	650	2,705	5.4	1.7	7.1	0.7
2017	2,055	650	2,705	5.4	1.7	7.1	0.7
2018	2,055	650	2,705	5.4	1.7	7.1	0.7
2019	673	650	1,323	1.8	1.7	3.5	0.7
2020		650	650		1.7	1.7	0.7
2021		650	650		1.7	1.7	0.7
2022		650	650		1.7	1.7	0.7
2023		650	650		1.7	1.7	0.7
2024		650	650		1.7	1.7	0.7
Total 2015-24	8,893	6,500	15,393	23.2	17.0	40.2	6.8

(a) Calculated by multiplying the MTU as UF6 value by a conversion factor of 0.00261285.
(b) NNSA barters are in the form of 4.95 w/o EUP and therefore have enrichment content.

Table 3.2 DOE Inventory Transfers in Exchange for Services (Barters) - Scenario 1

[16] These are referred to as being "net" amounts of materials and services since they account for any natural uranium diluent that would be purchased in the commercial market to support the down blending of HEU.

Year	MTU as UF_6			Equivalent Million Pounds of U_3O_8 (a)			SWU (Millions) (b)
	EM Barters	NNSA Barters	Total	EM Barters	NNSA Barters	Total	NNSA Barters
2012	1,601	176	1,777	4.2	0.5	4.6	0.3
2013	2,400	452	2,852	6.3	1.2	7.5	0.5
2014	2,055	650	2,705	5.4	1.7	7.1	0.7
2015	1,410	445	1,855	3.7	1.2	4.8	0.5
2016	1,410	445	1,855	3.7	1.2	4.8	0.5
2017	1,410	445	1,855	3.7	1.2	4.8	0.5
2018	1,410	445	1,855	3.7	1.2	4.8	0.5
2019	1,410	445	1,855	3.7	1.2	4.8	0.5
2020	1,410	445	1,855	3.7	1.2	4.8	0.5
2021	431	445	876	1.1	1.2	2.3	0.5
2022		445	445		1.2	1.2	0.5
2023		445	445		1.2	1.2	0.5
2024		445	445		1.2	1.2	0.5
Total 2015-24	8,891	4,450	13,341	23.2	11.6	34.9	4.7

(a) Calculated by multiplying the MTU as UF6 value by a conversion factor of 0.00261285.

(b) NNSA barters are in the form of 4.95 w/o EUP and therefore have enrichment content.

Table 3.3 DOE Inventory Transfers in Exchange for Services (Barters) - Scenario 2

Year	MTU as UF_6			Equivalent Million Pounds of U_3O_8 (a)			SWU (Millions) (b)
	EM Barters	NNSA Barters	Total	EM Barters	NNSA Barters	Total	NNSA Barters
2012	1,601	176	1,777	4.2	0.5	4.6	0.3
2013	2,400	452	2,852	6.3	1.2	7.5	0.5
2014	2,055	650	2,705	5.4	1.7	7.1	0.7
2015							
2016							
2017							
2018							
2019							
2020							
2021							
2022							
2023							
2024							
Total 2015-24	0	0	0	0.0	0.0	0.0	0.0

(a) Calculated by multiplying the MTU as UF6 value by a conversion factor of 0.00261285.

(b) NNSA barters are in the form of 4.95 w/o EUP and therefore have enrichment content.

Table 3.4 DOE Inventory Transfers in Exchange for Services (Barters) - Scenario 3

The combined EM and NNSA barters average 1,539 MTU as UF_6 per year between 2015 and 2024 for Scenario 1, declining to 1,334 MTU for Scenario 2 and 0 MTU for Scenario 3. Scenario 2 is 850 MTU per year (31%) lower than Scenario 1 through 2018, but is on average 655 MTU per year higher in 2019 to 2021. Average enrichment services between 2015 and 2024 for Scenario 2 are about 0.2 million SWU per year (32%) lower than Scenario 1 due to the lower rate of NNSA barters.

3.3 Proposed DOE Inventory Transfers Currently Under Negotiation

Additional high-assay[17] DUF_6, which may be economically viable for the purpose of enrichment to NU-equivalent or to LEU, is the only significant remaining excess inventory with potential market value that DOE can introduce into the commercial markets. DOE released a RFO for its remaining inventories of high-assay DUF_6, as well as for small quantities of off-spec LEU, in July 2013.[18] The RFO specified that natural uranium created from the DUF_6 could not enter the market before 2019 and would be limited to 2,000 MTU natural uranium equivalent per year. At the end of November 2013, DOE announced it would open negotiations with GLE for the transfer of high-assay DUF_6. GLE proposed to license, construct and operate a new laser enrichment facility at Paducah utilizing Silex technology for the processing of the tails material. The proposed Paducah Laser Enrichment Facility would re-enrich the DUF_6, creating natural uranium in the form of UF_6 that would then be sold into the uranium market. Commercial negotiations were originally expected to be concluded in early 2014, but they are still ongoing. No announcements have been made concerning when an agreement might be reached. GLE had notified the NRC that it intended to submit a license application for the Paducah Laser Enrichment Facility in September 2014, but has yet to do so. GLE did announce in July 2014 that it was curtailing its development activities due to poor enrichment market conditions. Following the successful completion of negotiations, GLE will need to apply for a license to construct and operate the Paducah Laser Enrichment facility from the U.S. NRC. ERI does not believe operations could begin until the year 2020 at the earliest. While additional delays seem possible, this analysis continues to assume operations could begin in the year 2020 per DOE's direction.

In addition to the DUF_6, the unallocated DOE excess inventories include a small quantity of off-spec non-UF_6, with product assays ranging between 0.711 w/o and 4.9 w/o and a small quantity of off-spec LEU with an average assay of 1.6 w/o. In 2009, the Portsmouth DOE contractor issued an RFP to sell certain off-spec non-UF_6 material. In November 2013 DOE also announced that it had entered into negotiations with AREVA for the

[17] DOE considers DUF_6 with an assay of 0.34 w/o U^{235} or higher to be potentially viable economically for the purpose of enrichment to NU-equivalent or LEU. DOE's inventory of such high-assay DUF_6 is 114,000 MTU as DUF_6.

[18] U. S. DOE, Portsmouth/Paducah Project Office, Request for Offers for the Sale of Depleted and Off-Specification Uranium Hexafluoride Inventories, Request for Offers Number: DE-SOL-0005845, July 3, 2013.

commercialization of the off-spec LEU material. No decision has yet been made as to whether any material will be sold under the 2009 RFP or the 2013 RFO. DOE continues to expect that a small amount of the off-spec non-UF_6 will enter the commercial markets in 2015 and 2016 followed by the off-spec LEU between 2019 and 2023. The natural uranium equivalent quantity of the off-spec non-UF_6 affecting the market in 2015 and 2016 totals 30 MTU while the off-spec LEU affecting the market in 2019 to 2023 totals 482 MTU as natural uranium equivalent.

The material transfers that would result from the negotiations associated with DOE inventory RFOs are summarized in Table 3.5. Note that the off-spec material has a small enrichment equivalent, estimated by ERI to be about 0.1 million SWU in total. The quantities shown in Table 3.5 are unchanged from the April 2014 ERI market analysis.

Year	Natural Uranium Equivalent, MTU				Equivalent Million Pounds of U_3O_8 (a)			
	DUF_6	Off-Spec LEU	Off-Spec non-UF_6	Total	DUF_6	Off-Spec LEU	Off-Spec non-UF_6	Total
2012								
2013								
2014								
2015			15	15			0.0	0.0
2016			15	15			0.0	0.0
2017								
2018								
2019		96		96		0.3		0.3
2020	2,000	96		2,096	5.2	0.3		5.5
2021	2,000	96		2,096	5.2	0.3		5.5
2022	2,000	96		2,096	5.2	0.3		5.5
2023	2,000	96		2,096	5.2	0.3		5.5
2024	2,000			2,000	5.2			5.2
Total 2015-24	10,000	482	30	10,512	26.1	1.3	0.1	27.5

(a) Calculated by multiplying the MTU as UF6 value by a conversion factor of 0.00261285.

(b) The Off-Spec LEU averages 1.6 w/o with an estimated enrichment equivalent of approximately 0.1 million SWU total. The total enrichment content of the Off-Spec Non-UF6 is estimated as less than 0.03 Million SWU.

Table 3.5 Proposed DOE Inventory Transfers Currently Under Negotiation

3.4 Summary of All DOE Material Affecting the Commercial Markets

As described in the previous sections, there are three broad categories of material for uranium originally attributable to DOE which are expected to be introduced into the commercial markets. They include (i) historical DOE transfers, the uranium from which will continue to displace commercial supply in the markets, as presented in Table 3.1; (ii) planned inventory transfers in exchange for services (barters) for three scenarios, as presented in Tables 3.2, 3.3 and 3.4; and (iii) proposed transfers of additional DUF_6, off-spec LEU, and off-spec non-UF_6 that are currently under negotiation with selected companies, as a result of earlier DOE RFOs as presented in Table 3.5. Combining the above categories results in three separate scenarios for DOE inventory affecting the commercial markets.

The schedule and quantities of DOE inventory affecting the commercial uranium and conversion markets is shown in Figure 3.1 for Scenario 1. The planned barters are the primary source of DOE inventory affecting the market over the next four years (through 2018). The proposed transfers of DOE inventory, which are currently under negotiation with selected companies as a result of earlier DOE RFOs, are the primary source of DOE inventory affecting the market in the longer term (2020 and beyond). They are shown with a dashed outline in Figure 3.1 as they are more tentative at present and include proposed transfers of DUF_6, off-spec LEU, and a limited amount of off-spec non-UF_6.

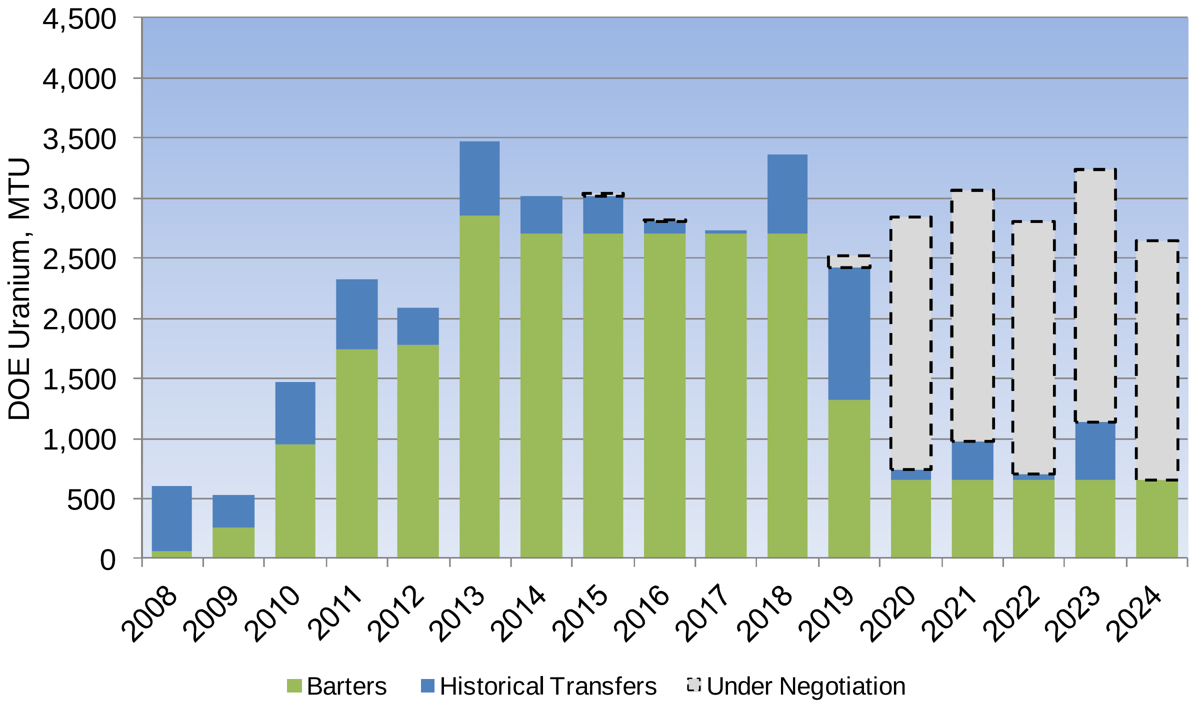


Figure 3.1 DOE Inventory Affecting the Commercial Uranium Market - Scenario 1

The schedule and quantities of DOE inventory affecting the commercial uranium and conversion markets for Scenario 2 are shown in Figure 3.2. Figure 3.2 demonstrates how the DOE uranium and conversion quantities decline in the near term over the years 2015 to 2018 for Scenario 2 when compared to Scenario 1. The DOE inventory quantities are higher for Scenario 2 in the years 2019 to 2021, as some of the EM and NNSA barters are deferred into those years when compared to the more accelerated schedule assumed in Scenario 1.

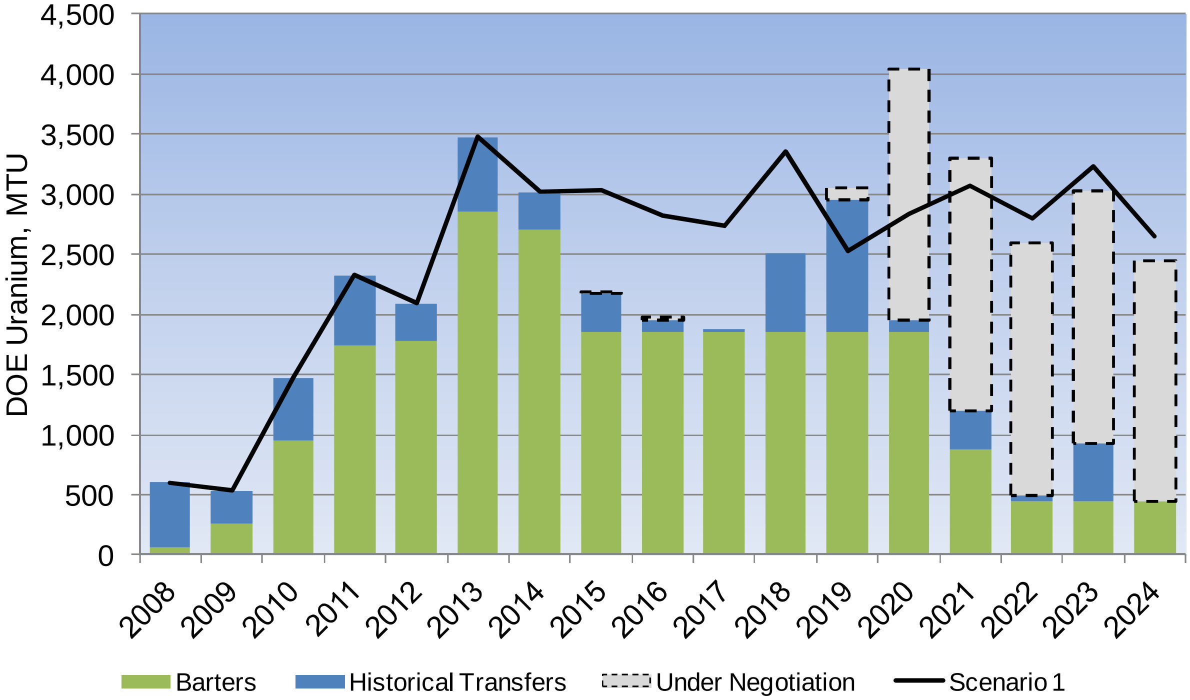


Figure 3.2 DOE Inventory Affecting the Commercial Uranium Market - Scenario 2

The schedule and quantities of DOE inventory affecting the commercial uranium and conversion markets for Scenario 3 are shown in Figure 3.3. Figure 3.3 demonstrates the dramatic reduction in DOE uranium and conversion quantities over the next ten years (2015 to 2024) for Scenario 3 when compared to Scenario 1 due to the assumed immediate cessation of EM and NNSA barters.

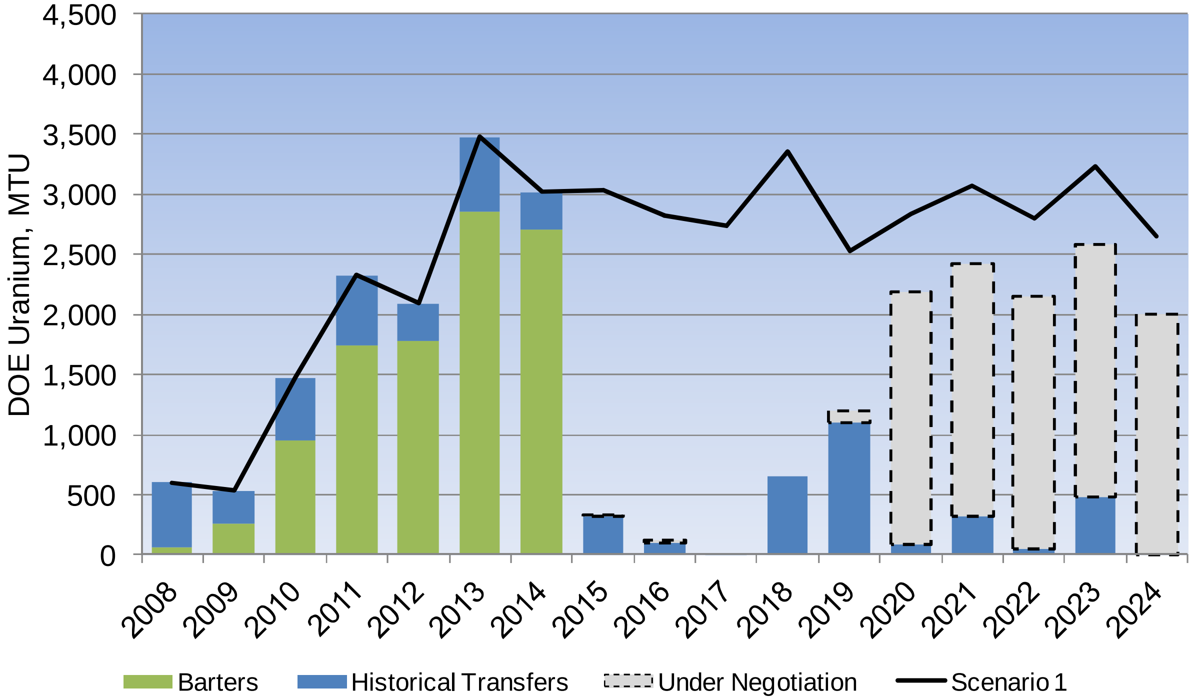


Figure 3.3 DOE Inventory Affecting the Commercial Uranium Market - Scenario 3

Table 3.6 compares the annual and total equivalent net uranium concentrates contained in the uranium attributable to DOE transfers based on when the material supplies the commercial uranium market for the three scenarios. During the period 2015 to 2024, the total DOE inventory affecting the conversion market ranges from as much as 76 million pounds U_3O_8 for Scenario 1 to as little as 36 million pounds U_3O_8 for Scenario 3. The quantity of DOE material affecting the commercial uranium market in 2012 through 2014 is also shown for comparison.

Year	Equivalent Million Pounds of U_3O_8		
	Scenario 1	Scenario 2	Scenario 3
2012	5.5	5.5	5.5
2013	9.1	9.1	9.1
2014	7.9	7.9	7.9
2015	7.9	5.7	0.9
2016	7.4	5.2	0.3
2017	7.1	4.9	0.1
2018	8.8	6.6	1.7
2019	6.6	8.0	3.1
2020	7.4	10.6	5.7
2021	8.0	8.6	6.3
2022	7.3	6.8	5.6
2023	8.4	7.9	6.8
2024	6.9	6.4	5.2
Total 2015-2024:			
	76.0	70.6	35.7

Table 3.6 Total Equivalent Net Million Pounds of U_3O_8 Affecting the Uranium Market

Table 3.7 compares the annual and total equivalent net natural UF_6 contained in the uranium attributable to DOE transfers based on when the material supplies the commercial conversion market for the three scenarios. During the period 2015 to 2024, the total DOE inventory affecting the conversion market ranges from as much as 29 million KgU for Scenario 1 to less than 14 million kgU for Scenario 3. The quantity of DOE material affecting the commercial conversion market in 2012 through 2014 is also shown for comparison.

Year	MTU as UF_6		
	Scenario 1	Scenario 2	Scenario 3
2012	2,095	2,095	2,095
2013	3,479	3,479	3,479
2014	3,023	3,023	3,023
2015	3,038	2,188	333
2016	2,825	1,975	120
2017	2,733	1,883	28
2018	3,358	2,508	653
2019	2,525	3,057	1,202
2020	2,839	4,044	2,189
2021	3,070	3,296	2,420
2022	2,802	2,597	2,152
2023	3,233	3,028	2,583
2024	2,650	2,445	2,000
Total 2015-2024:			
	29,075	27,023	13,682

Table 3.7 Total Equivalent Net MTU Affecting the Conversion Market

Table 3.8 compares the annual and total equivalent net enrichment services contained in the uranium attributable to DOE transfers based on when the material supplies the commercial enrichment market for the three scenarios. During the period 2015 to 2024, the total DOE inventory affecting the enrichment market ranges from as much as 11 million SWU for Scenario 1 to as little as 4.2 million SWU for Scenario 3. The quantity of DOE material affecting the commercial enrichment market in 2012 through 2014 is also shown for comparison.

The enrichment quantities are potentially subject to some offsets when evaluating the effect on industry. The LEU created from DUF_6 transferred to ENW contains 3.2 million SWU, but was offset by the purchase of a combined 4.4 million SWU in 2012 and 2013 from USEC. In order to be conservative, this analysis treats the enrichment content of the ENW LEU created from DUF_6 as a potential market effect. The processing of additional DUF_6 by GLE, which is currently under negotiation between GLE and DOE as a result of DOE's 2013 RFO, effectively creates a new demand on U.S. industry for an estimated 1.6 million SWU per year (starting in 2020). Again, to be conservative, this analysis does not treat the new GLE enrichment demand as an offset to the enrichment content of other DOE inventory affecting the commercial enrichment market.

Year	Equivalent SWU (Millions)		
	Scenario 1	Scenario 2	Scenario 3
2012	1.0	1.0	1.0
2013	0.8	0.8	0.8
2014	1.3	1.3	1.3
2015	1.5	1.2	0.8
2016	0.9	0.7	0.3
2017	0.9	0.6	0.2
2018	1.2	0.9	0.5
2019	1.2	1.0	0.6
2020	1.2	1.0	0.5
2021	1.3	1.0	0.6
2022	1.1	0.9	0.4
2023	1.1	0.8	0.4
2024	0.7	0.5	0.0
Total 2015-2024:			
	11.0	8.8	4.2

Table 3.8 Total Equivalent Net Million SWU Affecting the Enrichment Market

DOE Inventory Material Affecting the Spot Markets

As previously stated, it has been assumed that 50% of the natural uranium that DOE transfers to the contractor(s) via EM barters is introduced through spot market contracts and 50% through term market contracts. While Traxys has reported that as much as 90% of the conversion supply from EM barters in 2015 and 2016 has already been sold into forward contracts, ERI has conservatively assumed that 50% of the conversion services contained in the EM barters is sold on the spot market.[19] It is assumed that 100% of the natural uranium content of the NNSA barters is introduced into the spot market. The historical transfer of high assay DUF_6 and BLEU material from off-spec HEU are used by TVA and ENW under long-term arrangements. Proposed transfers of DOE inventory currently under negotiation as a result of DOE RFOs (primarily additional high assay DUF_6), are assumed to be introduced on a 50% spot and 50% term basis. This is considered a conservative assumption, as the uranium created from DUF_6 in the future may well enter the market on a term basis only, as was the case with the first DUF_6 transfer. The total amount of DOE inventory affecting the commercial spot markets is shown in Table 3.9 for the uranium spot market, Table 3.10 for the conversion spot market and Table 3.11 for the

[19] Smith, Kevin P., Traxys North America LLC, Managing Director for Uranium Marketing and Trading, Declaration of Kevin P. Smith, Attachment 6 to Defendant's Opposition to Plaintiff's Motion for Preliminary Injunction, Case No. 1:14-cv-1012-RBW, Document 17-7, Filed July 7, 2014, at 23.

enrichment spot market. A comparison of Table 3.6 with Table 3.9 and Table 3.7 with Table 3.10 indicates that 56% of the uranium and conversion components of the DOE inventories delivered into the commercial markets over the next ten years are expected to take place under spot market contracts for Scenario 1, declining to 52% for Scenario 2 and 38% for Scenario 3. As noted above, based on information reported by Traxys regarding the percentage of EM barter material that it sells through spot market contracts, ERI views these percentages as a conservative calculation. A comparison of Table 3.8 with Table 3.11 indicates that 62% of the enrichment component of the DOE inventories delivered into the commercial markets over the next ten years is expected to take place under spot market contracts for Scenario 1, declining to 53% for Scenario 2 and 1% for Scenario 3.

Year	Equivalent Million Pounds of U_3O_8		
	Scenario 1	Scenario 2	Scenario 3
2012	2.6	2.6	2.6
2013	4.3	4.3	4.3
2014	4.4	4.4	4.4
2015	4.4	3.0	0.0
2016	4.4	3.0	0.0
2017	4.4	3.0	0.0
2018	4.4	3.0	0.0
2019	2.7	3.1	0.1
2020	4.4	5.7	2.7
2021	4.4	4.5	2.7
2022	4.4	3.9	2.7
2023	4.4	3.9	2.7
2024	4.3	3.8	2.6
Total 2015-2024:			
	42.3	37.0	13.7

Table 3.9 Total DOE Inventory Affecting the Uranium Spot Market

Year	MTU as UF_6		
	Scenario 1	Scenario 2	Scenario 3
2012	977	977	977
2013	1,652	1,652	1,652
2014	1,678	1,678	1,678
2015	1,685	1,158	8
2016	1,685	1,158	8
2017	1,678	1,150	0
2018	1,678	1,150	0
2019	1,035	1,198	48
2020	1,698	2,198	1,048
2021	1,698	1,709	1,048
2022	1,698	1,493	1,048
2023	1,698	1,493	1,048
2024	1,650	1,445	1,000
Total 2015-2024:			
	16,203	14,152	5,256

Table 3.10 Total DOE Inventory Affecting the Conversion Spot Market

Year	Equivalent SWU (Millions)		
	Scenario 1	Scenario 2	Scenario 3
2012	0.3	0.3	0.3
2013	0.5	0.5	0.5
2014	0.7	0.7	0.7
2015	0.7	0.5	0.0
2016	0.7	0.5	0.0
2017	0.7	0.5	0.0
2018	0.7	0.5	0.0
2019	0.7	0.5	0.0
2020	0.7	0.5	0.0
2021	0.7	0.5	0.0
2022	0.7	0.5	0.0
2023	0.7	0.5	0.0
2024	0.7	0.5	0.0
Total 2015-2024:			
	6.9	4.7	0.1

Table 3.11 Total DOE Inventory Affecting the Enrichment Spot Market

DOE Inventory Material Share of U.S. and World Requirements

The commercial supply displaced by uranium attributable to DOE transfers is expected to average 2,908 MTU as UF_6, equivalent to 7.6 million pounds U_3O_8 per year over the next ten years (2015 through 2024) in Scenario 1. The quantity of DOE material released has been compared to total U.S. requirements in the past (e.g. the 10% guideline contained in the Excess Inventory Management Plan published by DOE in December 2008). Given that the uranium, conversion and enrichment markets are global[20], ERI does not find the share of U.S. requirements to be a particularly useful measure of the effect of the DOE transfers on commercial markets. Nonetheless, a summary is provided in Table 3.12 for the three scenarios. The DOE shares are summarized for three periods: recent (2012-2014), near term (2015-2017) and ten year forward (2015-2024). For Scenario 1, the DOE inventory share of U.S. uranium and conversion requirements is 16% to 17% in each of the periods, while the share of U.S. enrichment requirements is 7%. Scenario 2 demonstrates a noticeable reduction in the share of U.S. uranium and conversion requirements in the near term, as the share declines to 11%. However the U.S. share decline is only about 1% over the ten year forward period as the EM barters are extended but still are the same in total for Scenarios 1 and 2. The share of enrichment requirements declines slightly to 6% for Scenario 2. Scenario 3 demonstrates a significant reduction in the near term for uranium and conversion to just 1% of U.S. requirements and a halving of the share of all three components over the ten year forward period (down to 8% for uranium and conversion and to 3% for enrichment).

[20] The uranium, conversion and enrichment markets are global in nature. End-users purchase from suppliers worldwide in each of these industries and suppliers worldwide are generally able to sell into markets in all regions, not just to the region in which the supplier is located.

Period	DOE Inventory Share		
	Scenario 1	Scenario 2	Scenario 3
Share of U.S. Uranium Requirements			
Recent: 2012-14	16%	16%	16%
Near Term: 2015-17	16%	11%	1%
Ten Year: 2015-24	17%	15%	8%
Share of U.S. Conversion Requirements			
Recent: 2012-14	16%	16%	16%
Near Term: 2015-17	16%	11%	1%
Ten Year: 2015-24	17%	16%	8%
Share of U.S. Enrichment Requirements			
Recent: 2012-14	7%	7%	7%
Near Term: 2015-17	7%	6%	3%
Ten Year: 2015-24	7%	6%	3%

Table 3.12 DOE Inventory Shares of U.S. Requirements

It is important to realize that the uranium, conversion and enrichment markets are global in nature. End-users purchase from sources globally and suppliers make sales throughout the world.[21] It is therefore more useful to compare DOE inventory quantities to total world requirements rather than just U.S. requirements as has been done in Table 3.13. Unsurprisingly, the DOE inventory shares are lower as the U.S. requirements comprise a fraction of world requirements. For Scenario 1, the DOE inventory share of world uranium and conversion requirements is 4% to 5% in each of the periods, while the share of U.S. enrichment requirements is 2% to 3%. Scenario 2 demonstrates the reduction in the share of U.S. uranium and conversion requirements in the near term, as the share declines to 3%. Scenario 3 demonstrates a significant reduction in the near term for all three components to 1% or less of world requirements and a halving of the share over the ten year forward period (down to 2% for uranium and conversion and to 1% for enrichment).

[21] There are some exceptions, as the C.I.S. and Eastern European markets are effectively captive to Russian supply (although Russia does have access to uranium supply outside of Russia and Kazakhstan) and the growing Chinese market fills the majority (but not all) of its conversion and enrichment requirements internally. Note that both AREVA and Rosatom supply EUP containing conversion and enrichment services while Urenco supplies a small amount of enrichment services to China.

Period	DOE Inventory Share		
	Scenario 1	Scenario 2	Scenario 3
Share of World Uranium Requirements			
Recent: 2012-14	5%	5%	5%
Near Term: 2015-17	4%	3%	0%
Ten Year: 2015-24	4%	4%	2%
Share of World. Conversion Requirements			
Recent: 2012-14	5%	5%	5%
Near Term: 2015-17	5%	3%	0%
Ten Year: 2015-24	4%	4%	2%
Share of World Enrichment Requirements			
Recent: 2012-14	3%	3%	3%
Near Term: 2015-17	2%	2%	1%
Ten Year: 2015-24	2%	2%	1%

Table 3.13 DOE Inventory Shares of World Requirements

As noted in the footnote on the previous page, some markets are not fully open to the domestic industries, in particular China and the C.I.S./Eastern Europe are considered by some in the industry to be inaccessible for conversion and enrichment services. To be conservative, China has been assumed to be inaccessible for new conversion and enrichment services contracts, even though AREVA and Rosatom currently supply EUP containing conversion and enrichment services and Urenco supplies a small amount of enrichment services to China. China is considered to be accessible for uranium sales while the C.I.S./Eastern Europe is conservatively assumed to be closed. Table 3.14 compares DOE inventory quantities to total world requirements markets accessible to the domestic industry. The results are similar to the total world shares but 1% to 2% higher.

Period	DOE Inventory Share		
	Scenario 1	Scenario 2	Scenario 3
Share of Accessible World Uranium Requirements			
Recent: 2012-14	6%	6%	6%
Near Term: 2015-17	5%	4%	0%
Ten Year: 2015-24	5%	4%	2%
Share of Accessible World. Conversion Requirements			
Recent: 2012-14	7%	7%	7%
Near Term: 2015-17	7%	5%	0%
Ten Year: 2015-24	6%	6%	3%
Share of Accessible World Enrichment Requirements			
Recent: 2012-14	3%	3%	3%
Near Term: 2015-17	3%	3%	1%
Ten Year: 2015-24	3%	2%	1%

Table 3.14 DOE Inventory Shares of Accessible World Requirements

4. Quantification of the Effect of DOE Material on the Commercial Markets

4.1 Potential Effect of DOE Inventory on Market Prices

ERI continues to believe that attributing a difference in market price to DOE inventory releases provides an important measure of the DOE material's effect on the domestic industry. However, there is no absolute measure of the isolated effect any one particular market factor or event, such as the DOE inventory material, has on market prices. There are many market factors which combine to determine the relationship between supply and demand, and ultimately market prices as found in published price indicators. DOE inventory releases are certainly one of the market factors, but the DOE inventory must be judged in the context of its relative importance when compared to other market factors. A reasonable judgment on the specific contribution of DOE transfers to observed market price changes can then be made.

By applying the results of ERI's economic market clearing price analysis regarding the predicted effect of an incremental addition of supply on the market clearing price of uranium concentrates, conversion services and enrichment services, respectively, to the equivalent nuclear fuel materials and services contained in DOE's inventory transfers, the effect on market price may be estimated as presented below.

4.1.1 Potential Effect of DOE Inventory on Market Prices Based on Market Clearing Price Analysis

As was done in the April 2014 ERI market analysis, a market clearing price approach has been employed to determine the effect of changes in individual components of supply on market prices. ERI chose the market clearing approach because it assumes an efficient allocation of resources in a competitive market and is consistent with the view that long term prices are determined by production costs and future supply-demand forecasts. Using this approach allows the price impact of any single supply component, such as DOE inventory, to be estimated. This market clearing approach requires the creation of an annual supply curve[22], which in the case of uranium concentrates is constructed by stacking individual increments of supply (e.g., individual mines) in ascending order from low to high based on each

[22] The supply curves are constructed from individual supply sources, e.g. individual uranium mines, conversion plants and enrichment plants. ERI gathers available information such as capital costs, operating costs, disposal costs, tax rates, royalties, interest rates, facility lifetime and production rate, etc. for each supply source. Where possible, discounted cash flow analyses are performed for each supply source to determine the levelized, constant dollar price which will generate a reasonable rate of return, typically assumed to be 15% after taxes. Adjustments are made to account for foreign exchange rates as well as historical inflation. Sources of cost information include company financial reports, regulatory filings such as NI 43-101 technical reports, preliminary economic assessments, presentations at conferences, etc. The quality and timeliness of the available sources of cost information can vary. Information is limited or even non-existent for some individual supply increments.

increment's cost of production. The market clearing price is the total cost of production for the last increment of supply that is required to meet demand during that year. The supply curve created by ERI for the year 2013 is shown in Figure 4.1. Note that the supply curve assumes secondary supply is always utilized first, followed by primary production. In over supplied markets such as the current uranium market, the amount of mine production required to meet requirements, including normal strategic inventory building, is well below actual production.

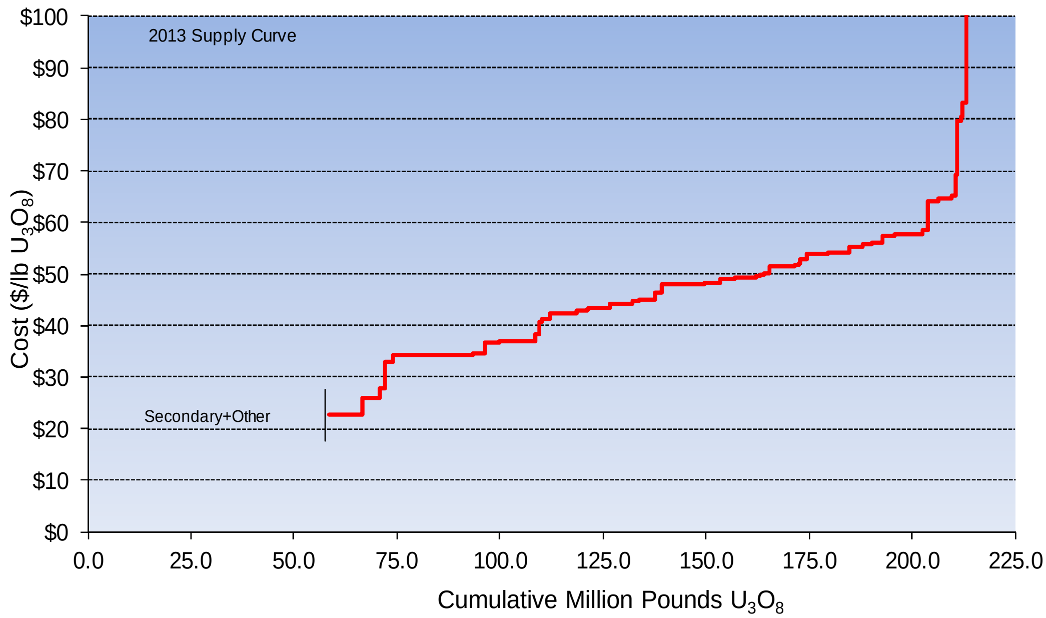
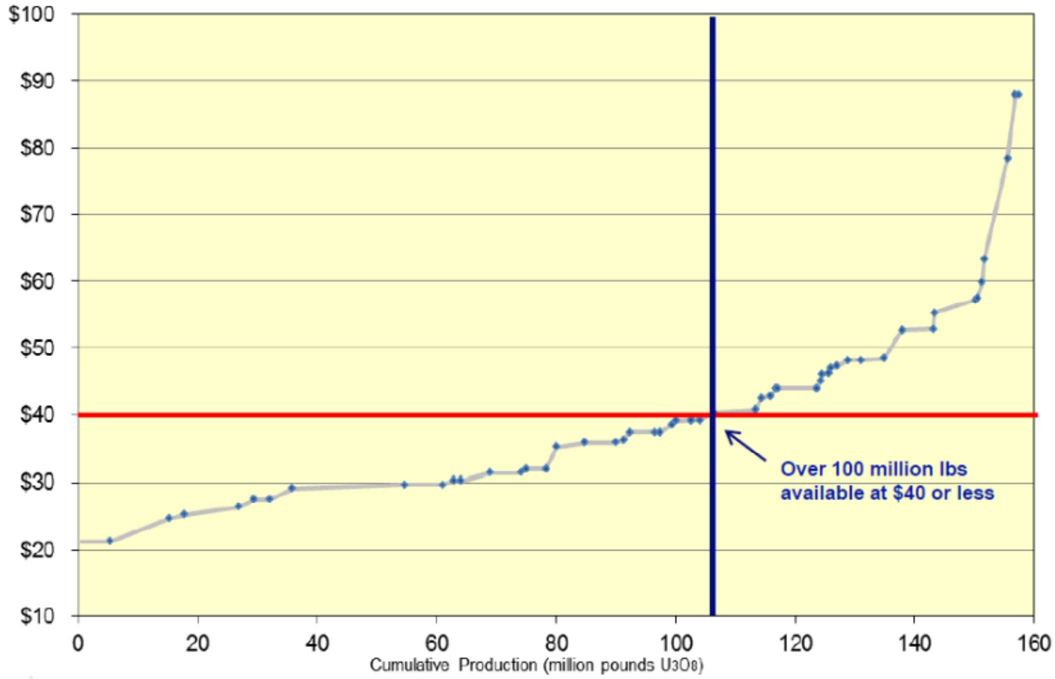


Figure 4.1 ERI Supply Curve for 2013

The change in market clearing price attributed to a particular component of secondary supply, such as the DOE inventory, is found by removing the market component in question from secondary supply. This has the effect of moving the supply curve to the left, resulting in a higher market clearing price for the same requirements. In a market with considerable oversupply such as today's market, the removal of a particular component of secondary supply does not result in a corresponding amount of new primary supply entering the market in its place, it instead reduces the amount of oversupply.

The relevant slope of the supply curve (i.e., Δ$ per pound / Δ million pounds) can be determined from the difference of two price points on the supply curve (e.g. clearing price with and without DOE inventory) divided by the quantity in question (e.g. the DOE inventory affecting the market). ERI has forecast the supply curve for each year in the next ten years, based on production and cost information about existing mines as well as expected mine developments, as well as secondary supply. Matching forecast requirements against that curve, ERI can forecast the slope at the relevant point, that is, the point on the supply curve where the demand curve intersects. Over the next ten years, the slope is projected to average $0.375 per pound U_3O_8 per one million pounds U_3O_8.

The supply curve developed by ERI appears to be consistent with the work of other market analysts[23,24], as shown in Figures 4.2 and 4.3. These supply curves examine total production cost and production cash cost, respectively. Each is consistent with a slope of \$0.40 per pound U_3O_8 for each one million pound change in supply in the relevant portion of the supply curve.

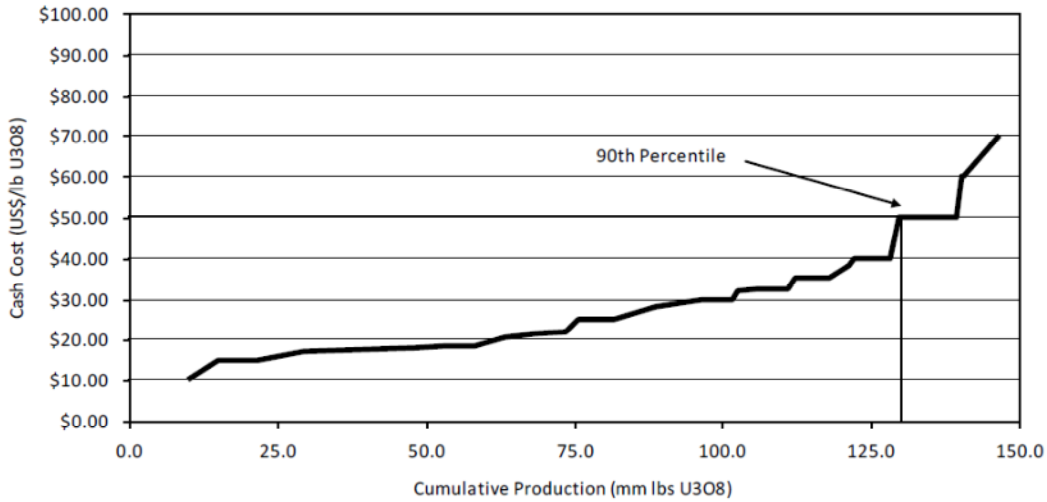


Source: UxC

Figure 4.2 UxC Production Cost Curve for 2013

[23] Ux Consulting Company, "Is \$35 the New \$10: A Case for Production Delays and Cutbacks", NEI International Uranium Fuel Seminar 2013, October 7, 2013

[24] RBC Capital Markets, Metal Prospects, "Uranium Metal Prospects: Uranium Market Outlook – Third Quarter 2013", June 18, 2013



Source: RBC

Figure 4.3 RBC Production Cash Cost Curve for 2013

Similar production cost analysis coupled with economic market clearing price analysis has been conducted for conversion and enrichment facilities. The supply curves are based on supply sources worldwide, not just in the U.S., as the uranium, conversion and enrichment markets are global in nature. The supply curve slopes used to determine the price effect of DOE material are $0.375 per pound U_3O_8 for each one million pound change in supply, $0.31 per kgU as UF_6 for each one million kgU change in conversion supply and $4.1 per SWU for each one million SWU change in enrichment supply. The supply curve slopes are the same as used in the April 2014 ERI market analysis.

The supply curve slopes for the uranium concentrates, conversion services, and enrichment services markets have been applied to the DOE inventory material affecting the commercial markets, which were summarized in Tables 3.6, 3.7 and 3.8 in Section 3. The resulting year-by-year changes in clearing price attributed to the DOE material are presented in Tables 4.1, 4.2 and 4.3 for the three scenarios considered. During the next ten years (2015-2024), the change in average clearing price attributed to the DOE inventories ranges between $2.8/lb and $1.3/lb for the uranium market across the three scenarios, between $0.90/kgU and $0.40/kgU for the conversion market and between $4.5/SWU and $1.7/SWU for the enrichment market. The price effects attributed to DOE inventory are already built into current market prices. If no DOE inventory releases took place, then current market prices would be higher by the amounts stated, e.g. by $3 per pound for uranium or by $1 per kgU for conversion services.

Year	Uranium ($/lb U_3O_8)		
	Scenario 1	Scenario 2	Scenario 3
2012	$2.1	$2.1	$2.1
2013	$3.4	$3.4	$3.4
2014	$3.0	$3.0	$3.0
2015	$3.0	$2.1	$0.3
2016	$2.8	$1.9	$0.1
2017	$2.7	$1.8	$0.0
2018	$3.3	$2.5	$0.6
2019	$2.5	$3.0	$1.2
2020	$2.8	$4.0	$2.1
2021	$3.0	$3.2	$2.4
2022	$2.7	$2.5	$2.1
2023	$3.2	$3.0	$2.5
2024	$2.6	$2.4	$2.0
Average 2015-2024:			
	$2.8	$2.6	$1.3

Table 4.1 Changes in Uranium Clearing Price Due to DOE Inventory

Year	Conversion ($/kgU)		
	Scenario 1	Scenario 2	Scenario 3
2012	$0.6	$0.6	$0.6
2013	$1.1	$1.1	$1.1
2014	$0.9	$0.9	$0.9
2015	$0.9	$0.7	$0.1
2016	$0.9	$0.6	$0.0
2017	$0.8	$0.6	$0.0
2018	$1.0	$0.8	$0.2
2019	$0.8	$0.9	$0.4
2020	$0.9	$1.3	$0.7
2021	$1.0	$1.0	$0.8
2022	$0.9	$0.8	$0.7
2023	$1.0	$0.9	$0.8
2024	$0.8	$0.8	$0.6
Average 2015-2024:			
	$0.9	$0.8	$0.4

Table 4.2 Changes in Conversion Clearing Price Due to DOE Inventory

Year	Enrichment ($/SWU)		
	Scenario 1	Scenario 2	Scenario 3
2012	$3.9	$3.9	$3.9
2013	$3.4	$3.4	$3.4
2014	$5.5	$5.5	$5.5
2015	$5.9	$5.1	$3.2
2016	$3.8	$3.0	$1.1
2017	$3.5	$2.6	$0.7
2018	$4.7	$3.9	$2.0
2019	$5.1	$4.2	$2.3
2020	$4.9	$4.0	$2.1
2021	$5.2	$4.3	$2.4
2022	$4.6	$3.7	$1.8
2023	$4.4	$3.5	$1.6
2024	$2.8	$1.9	$0.0
Average 2015-2024:			
	$4.5	$3.6	$1.7

Table 4.3 Changes in Enrichment Clearing Price Due to DOE Inventory

Clearing Price Effect Relative to Current Term Market Prices

Tables 4.4, 4.5 and 4.6 restate the changes in clearing price relative to current term market prices[25] for each of the scenarios in order to provide some additional perspective. This analysis does not make a projection of future term prices, but it can be noted that term prices are expected to increase (recover) in the future. The timing and magnitude of future price increases is uncertain, so a comparison of price effects relative to current term market prices is conservative. If term prices increase as expected, then the relative price impact on a percentage basis will be lower than shown in the tables. During the next ten years (2015-2024), the change in clearing price attributed to the DOE inventories relative to the current term market price averages approximately 6% for the uranium market, 6% for the conversion market and 5% for the enrichment market when Scenario 1 inventory release rates are assumed. The uranium and conversion price effect declines to 5% while the enrichment market declines to 4% for Scenario 2. The price effect declines to less than 3% for uranium and conversion and to 2% for enrichment when Scenario 3 DOE inventory release rates are assumed.

The DOE inventory price effects relative to current term market prices for Scenario 1 are similar to those calculated in the April 2014 ERI market analysis.

[25] TradeTech price indicators as of January 31, 2015.

Year	Uranium		
	Scenario 1	Scenario 2	Scenario 3
2012	3.4%	3.4%	3.4%
2013	6.3%	6.3%	6.3%
2014	6.4%	6.4%	6.4%
2015	6.0%	4.3%	0.7%
2016	5.5%	3.9%	0.2%
2017	5.4%	3.7%	0.1%
2018	6.6%	4.9%	1.3%
2019	4.9%	6.0%	2.4%
2020	5.6%	7.9%	4.3%
2021	6.0%	6.5%	4.7%
2022	5.5%	5.1%	4.2%
2023	6.3%	5.9%	5.1%
2024	5.2%	4.8%	3.9%
Average 2015-2024:			
	5.7%	5.3%	2.7%

Table 4.4 Changes in Uranium Clearing Price Relative to Current Term Market Price

Year	Conversion		
	Scenario 1	Scenario 2	Scenario 3
2012	3.9%	3.9%	3.9%
2013	6.6%	6.6%	6.6%
2014	5.9%	5.9%	5.9%
2015	5.9%	4.2%	0.6%
2016	5.5%	3.8%	0.2%
2017	5.3%	3.6%	0.1%
2018	6.5%	4.9%	1.3%
2019	4.9%	5.9%	2.3%
2020	5.5%	7.8%	4.2%
2021	5.9%	6.4%	4.7%
2022	5.4%	5.0%	4.2%
2023	6.3%	5.9%	5.0%
2024	5.1%	4.7%	3.9%
Average 2015-2024:			
	5.6%	5.2%	2.7%

Table 4.5 Changes in Conversion Clearing Price Relative to Current Term Market Price

Year	Enrichment		
	Scenario 1	Scenario 2	Scenario 3
2012	2.8%	2.8%	2.8%
2013	2.8%	2.8%	2.8%
2014	5.7%	5.7%	5.7%
2015	6.6%	5.6%	3.5%
2016	4.3%	3.3%	1.2%
2017	3.9%	2.9%	0.8%
2018	5.3%	4.3%	2.2%
2019	5.7%	4.7%	2.6%
2020	5.4%	4.4%	2.3%
2021	5.7%	4.7%	2.6%
2022	5.1%	4.1%	2.0%
2023	4.9%	3.9%	1.7%
2024	3.1%	2.1%	0.0%
Average 2015-2024:			
	5.0%	4.0%	1.9%

Table 4.6 Changes in Enrichment Clearing Price Relative to Current Term Market Price

Clearing Price Effect Relative to Current Spot Market Prices

Tables 4.7, 4.8 and 4.9 restate the changes in clearing price relative to current spot market prices, for each of the scenarios. It is noted that spot prices are expected to increase (recover) in the future. The timing and magnitude of future price increases is uncertain, so a comparison of price effects relative to current spot market prices is conservative. If spot prices increase as expected, then the relative price impact on a percentage basis will be lower than shown in the tables. During the next ten years (2015-2024), the change in clearing price attributed to the DOE inventories relative to the current spot market price averages 7.6% for the uranium market, 10.6% for the conversion market and 5.1% for the enrichment market when Scenario 1 inventory release rates are assumed. The uranium price effect declines to 7.1%, the conversion price effect declines to 9.9%, and the enrichment price effect declines to 4.1% for Scenario 2. The price effect, relative to current spot prices, declines to 3.6% for uranium, to 5.0% for conversion and to 1.9% for enrichment when Scenario 3 DOE inventory release rates are assumed.

The price effect relative to current spot markets is larger than relative to term market prices for uranium and particularly for conversion. Current enrichment spot and term market prices are about the same so there is no difference in relative price effect. The DOE inventory price effects relative to current spot market prices for Scenario 1 are similar to those calculated in the April 2014 ERI market analysis.

Year	Uranium		
	Scenario 1	Scenario 2	Scenario 3
2012	4.2%	4.2%	4.2%
2013	8.9%	8.9%	8.9%
2014	8.9%	8.9%	8.9%
2015	8.0%	5.8%	0.9%
2016	7.4%	5.2%	0.3%
2017	7.2%	5.0%	0.1%
2018	8.8%	6.6%	1.7%
2019	6.6%	8.0%	3.2%
2020	7.5%	10.6%	5.8%
2021	8.1%	8.7%	6.4%
2022	7.4%	6.8%	5.7%
2023	8.5%	8.0%	6.8%
2024	7.0%	6.4%	5.3%
Average 2015-2024:			
	7.6%	7.1%	3.6%

Table 4.7 Changes in Uranium Clearing Price Relative to Current Spot Market Price

Year	Conversion		
	Scenario 1	Scenario 2	Scenario 3
2012	7.9%	7.9%	7.9%
2013	11.2%	11.2%	11.2%
2014	12.3%	12.3%	12.3%
2015	11.1%	8.0%	1.2%
2016	10.3%	7.2%	0.4%
2017	10.0%	6.9%	0.1%
2018	12.2%	9.1%	2.4%
2019	9.2%	11.2%	4.4%
2020	10.4%	14.8%	8.0%
2021	11.2%	12.0%	8.8%
2022	10.2%	9.5%	7.8%
2023	11.8%	11.0%	9.4%
2024	9.7%	8.9%	7.3%
Average 2015-2024:			
	10.6%	9.9%	5.0%

Table 4.8 Changes in Conversion Clearing Price Relative to Current Spot Market Price

Year	Enrichment		
	Scenario 1	Scenario 2	Scenario 3
2012	3.0%	3.0%	3.0%
2013	3.1%	3.1%	3.1%
2014	5.9%	5.9%	5.9%
2015	6.8%	5.8%	3.6%
2016	4.4%	3.4%	1.2%
2017	4.0%	3.0%	0.8%
2018	5.4%	4.4%	2.2%
2019	5.8%	4.8%	2.6%
2020	5.5%	4.5%	2.3%
2021	5.9%	4.9%	2.7%
2022	5.2%	4.2%	2.0%
2023	5.0%	3.9%	1.8%
2024	3.2%	2.2%	0.0%
Average 2015-2024:			
	5.1%	4.1%	1.9%

Table 4.9 Changes in Enrichment Clearing Price Relative to Current Spot Market Price

4.1.2 Potential Effect of DOE Inventory on Uranium Spot Market Price

ERI has developed a multivariable correlation[26] between the monthly spot market prices for uranium concentrates published by TradeTech and the active spot market supply and active spot market demand, which are also published monthly by TradeTech. Active spot market supply is uranium available for sale and delivery within one year as of the date published. Active spot market demand is based on active inquiries to purchase uranium for delivery within one year as of the date published. Spot market volume (sales) and the spot market price in the preceding month are used in the correlation as well. The active supply and demand over a number of trailing months as well as for just the preceding month are used in the correlation. This correlation covers the period from July 2004 through November 30, 2014 and has an R^2 = 90%, which indicates a reasonable correlation, particularly given the extreme volatility experienced in the spot market price during this period. A comparison of

[26] The correlation was developed by using the least squares method to develop a linear curve fit between each of the independent variables and the spot market price. The curve fit is an equation of the form $y = m_1x_1 + m_2x_2 + \ldots + b$ where x_1, x_2, etc. are the values for each of the variables (active supply, active demand, etc.) and m_1, m_2, etc. are the variable coefficients which provide the best fit of the price returned by the correlation to the actual spot price.

the actual spot market prices with the price "predicted" by the correlation is provided in Figure 4.4

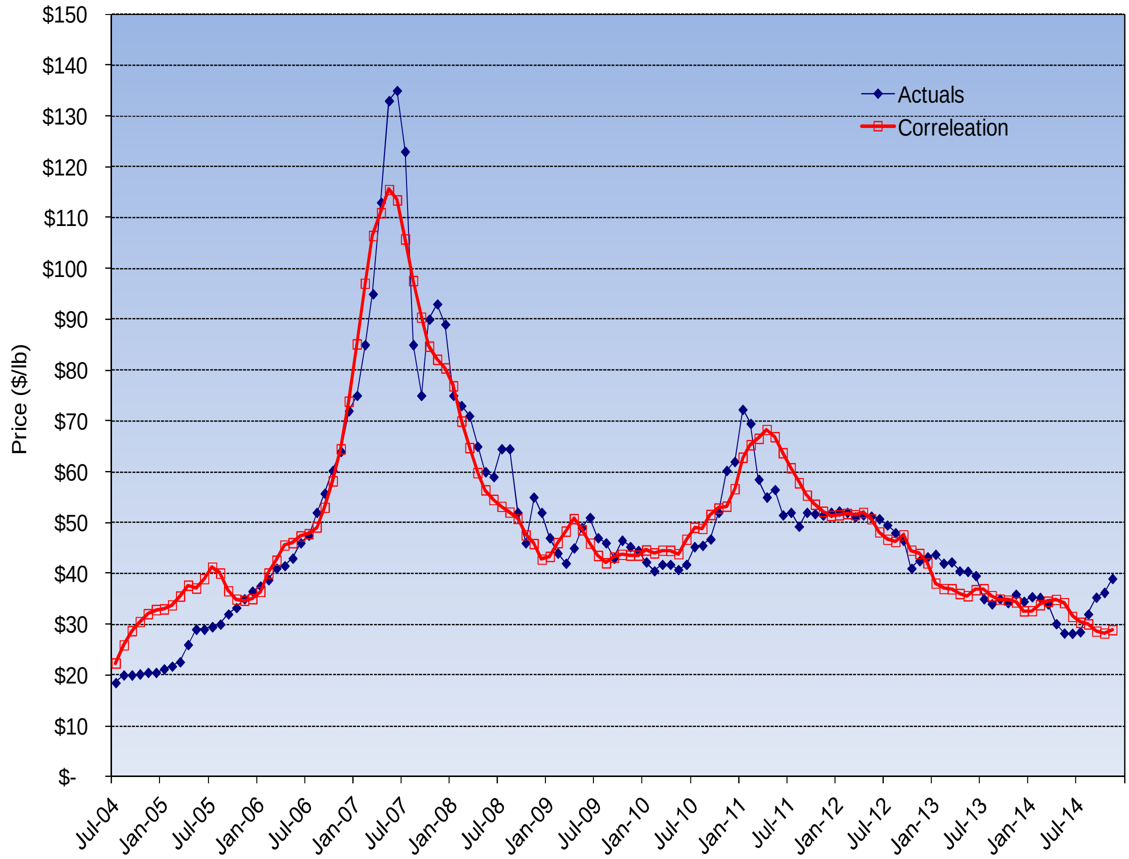


Figure 4.4 Spot Market Prices for Uranium – Actual versus Correlation

This correlation was then used to simulate[27] the 2009 through 2024 spot market price for uranium concentrates with and without the DOE inventory released to the spot market, as shown in Figure 4.5.

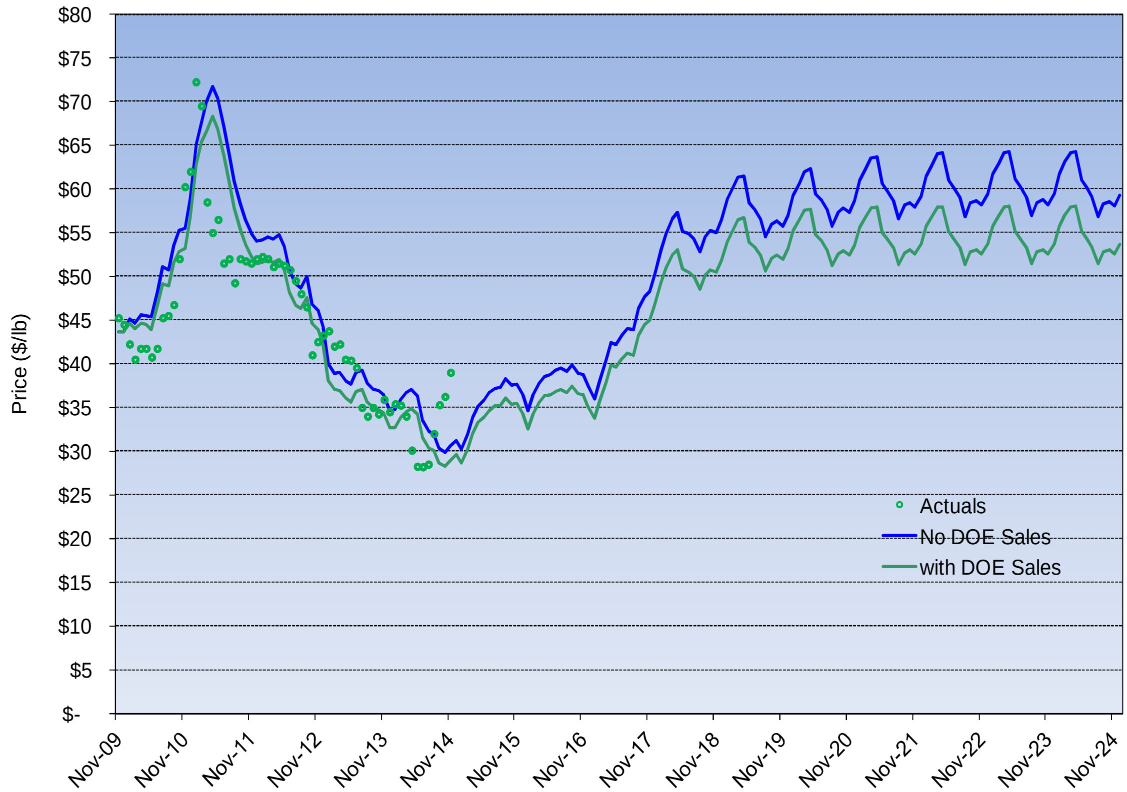


Figure 4.5 Estimate of Uranium Spot Market Price Change Due to Scenario 1 DOE Inventory Using Correlation

Historical auctions of DOE material were modeled as they took place. Since Traxys took over the commercialization of EM transfers, it is no longer possible to explicitly identify when and how much of this DOE origin material is introduced into the commercial markets by Traxys at any point in time. For use in the correlation, the DOE inventory is assumed to be released to the spot market evenly through the year, i.e. one-twelfth of the annual amount each month. The quantity of DOE material released to the spot market was developed in Table 3.9 of Section 3.4, which included the conservative assumption that 50% of sales of DOE material by Traxys take place under mid- and long-term contracts.[28,29]

[27] Future values of active supply and demand were projected based on historical values. Two projections of spot market price into the future using the correlation equation were then made - one assuming DOE material continues to contribute to active spot market supply and one which assumes DOE material no longer contributes. The difference between the two is the price effect of the DOE material.

[28] Smith, Kevin, Director Uranium Trading and Marketing, Traxys, Commercial View of DOE's 2013 Plan for Natural Uranium Barter Sales, Nuclear Energy Institute, International Uranium Fuel Seminar, October 6-

Applying the correlation results in an estimated spot market price effect of $2.2 per pound U_3O_8 over the last three years (2012-2014). Looking forward and assuming Scenario 1 DOE inventory release rates, the correlation results in projected spot market price effects of $2.4 per pound U_3O_8 over the next three years (2015-2017) rising to an average effect of $5.1 between 2018 and 2024 as spot market prices recover. This represents an estimated effect of 6% lower spot market prices over the next three years and 9% lower over the following seven years if Scenario 1 DOE inventory releases take place over the next ten years (2015-2024) compared to no release of DOE inventory. The price effect is on future spot market prices, which are projected to eventually rise with or without the DOE inventory releases as shown in Figure 4.5. The price effects attributed to past and current DOE inventory releases are already built into current spot market prices. If the past releases had not occurred, then current spot market prices would be higher by approximately $2 per pound U_3O_8. Under Scenario 2 the uranium spot price effect declines to $1.7 per pound U_3O_8 between 2015 and 2017 and to $4.8 between 2018 and 2024, while under Scenario 3 the uranium spot price effect is $0.3 per pound U_3O_8 between 2015 and 2017 and to $2.0 between 2018 and 2024.

In a paper[30] presented at the June 2013 World Nuclear Fuel Market meeting, industry consultant TradeTech estimated the effect on spot prices of DOE inventory releases to be $2/lb between mid-2012 and mid-2013.[31] TradeTech made use of its own econometric model which relates active spot market supply to active spot market demand to estimate the price effect of the DOE inventory releases. The analysis used in the presentation is not based on clearing price methodology, but does result in an estimation of price effect which is similar to the effect estimated by ERI using both the clearing price methodology and the econometric model.

4.2 Potential Effect on Domestic Industries

The potential effect of the entry of DOE materials and services into the commercial markets discussed above on each of these domestic industries is discussed further in the following sections.

9, 2013, San Antonio, Texas.

[29] Smith, Kevin P., Traxys North America LLC, Managing Director for Uranium Marketing and Trading, Declaration of Kevin P. Smith, Attachment 6 to Defendant's Opposition to Plaintiff's Motion for Preliminary Injunction, Case No. 1:14-cv-1012-RBW, Document 17-7, Filed July 7, 2014, at 7-12.

[30] TradeTech LLC, DOE Inventory: Impact & Consensus, World Nuclear Fuel Market, Istanbul, Turkey, June 2013.

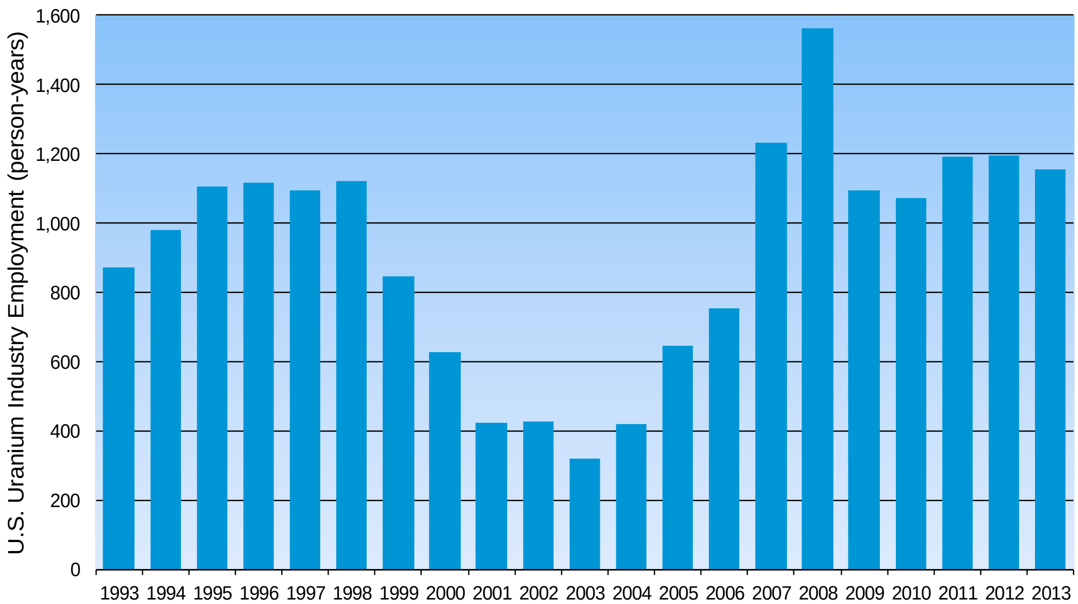
[31] This $2/lb impact between mid-2012 and mid-2013 is similar to the average market impact of $1.78 to $1.86/lb U_3O_8 for the period 2012 to 2020 calculated by ERI in its 2012 market impact study.

4.2.1 Potential Effect on the Domestic Uranium Concentrates Industry

ERI continues to believe that the change in market price provides the best measure of, and is the best singly proxy for, market effect. The analysis has been expanded to relate how a change in market price affects key metrics of the domestic uranium industry, in particular, employment and production.

U.S. Uranium Industry Employment

Total U.S. uranium industry employment, as measured by responses to U.S. Energy Information Administration Form EIA-858, has ranged between 321 and 1,563 person-years over the past 21 years. As shown in Figure 4.6, employment reached its low point in 2003, but then steadily increased over the following five years, peaking in 2008. The large employment gains in 2007 and 2008 were driven by the rapid run up in uranium prices, which resulted in increased employment at uranium production centers as well as increased exploration employment. Employment declined by 30% in 2009 as there was a sharp reduction in exploration, with reduced mining employment as well. The sudden decline appeared to be the result of the large price declines in 2008 and 2009 from the 2007 price peak. Mining industry employment in 2013 was reported as 1,156 person-years.



Source: U.S. Energy Information Administration, "Domestic Uranium Production Report" (2013),(2012),(2002).

Figure 4.6 U.S. Uranium Industry Employment History

U.S. uranium industry employment over the past ten years appears to respond to changes in uranium spot and term prices, as shown in Figure 4.7. In particular, it was found that changes in industry employment from year-to-year are correlated to the two-year average prices (current and preceding year) in constant dollars, as shown in Figure 4.8. Mining, milling and processing employment was found to be more closely correlated with the term price, while exploration employment was found to be more closely correlated with the spot price. The R^2 for the correlation is 0.81, indicating that 81% of the observed changes in employment are consistent with the observed changes in market price. The correlation indicates that industry employment in 2014 is expected to decline by 114 person-years from the 2013 value, or about 10% as shown in Figure 4.8. This estimation appears consistent with announcements that have been made by domestic industry participants. A small additional employment decline is projected for 2015. It is noted that the correlation projected a larger decline for 2013 than actually took place, although it is possible that some of the difference may be made up if the actual employment decline for 2014 is larger than projected by the correlation.

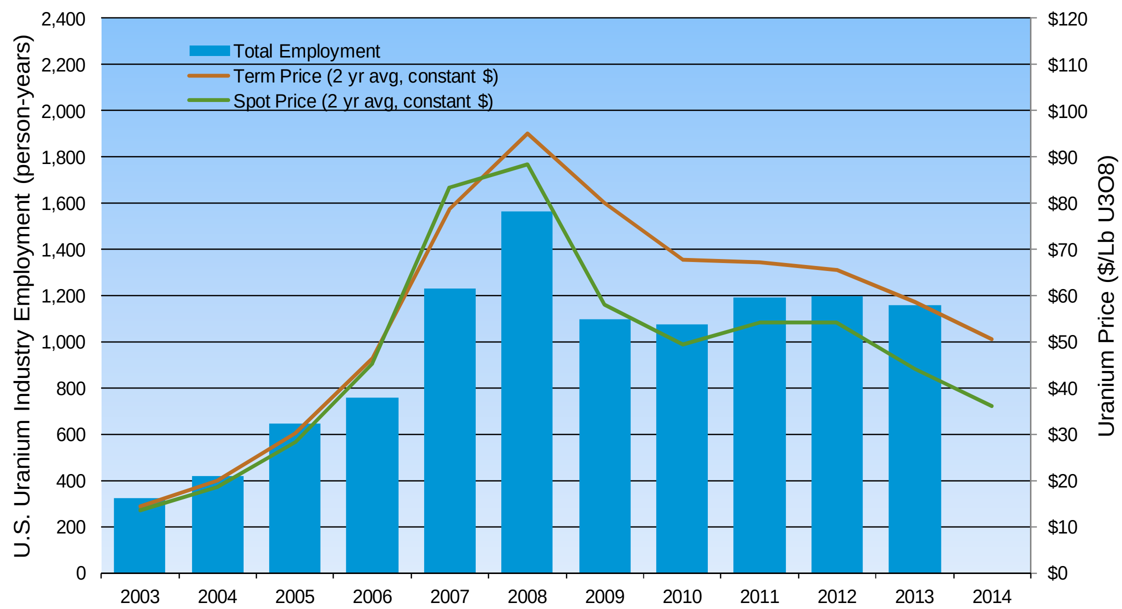
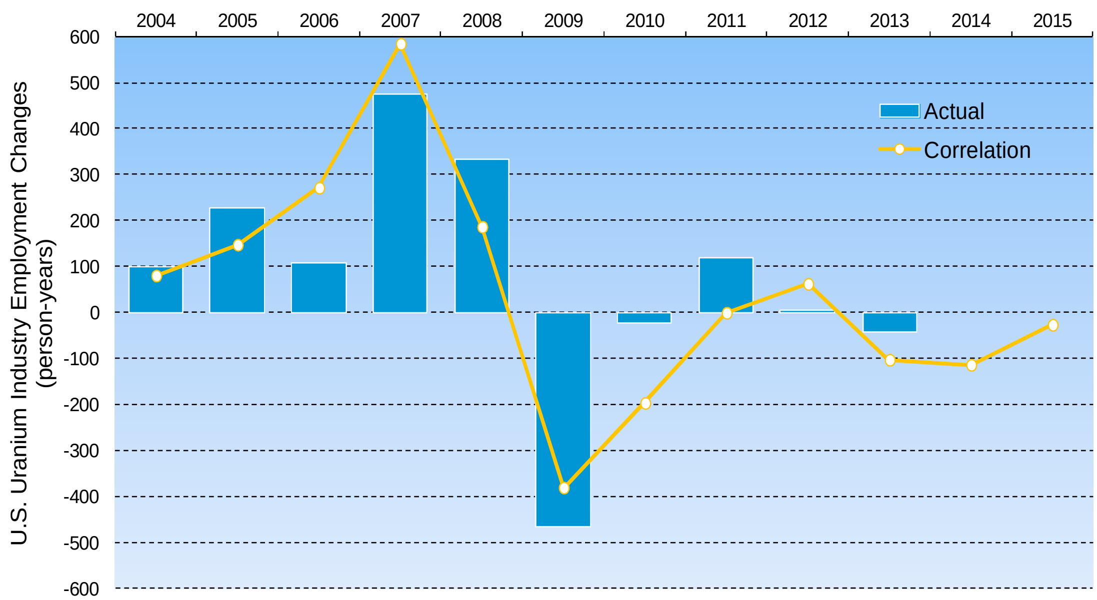


Figure 4.7 U.S. Uranium Industry Employment and Market Prices



Source: U.S. Energy Information Administration, "Domestic Uranium Production Report" (2013), (2012), (2002).
* 2014-2015 values estimated by Energy Resources International, Inc.

Figure 4.8 Change in U.S. Uranium Industry Employment - Actual and Projected

The price-employment correlation has been used to estimate the effect of the DOE inventory releases on U.S. uranium industry employment. The total price effect of DOE inventory releases is estimated to have averaged $2.7/lb in 2012-2013[32] and $3.2/lb in 2013-2014 (see Table 4.1). The correlation indicates the DOE price effect lowered employment by 41 person-years in 2013 and 44 person-years in 2014. In other words, employment was 3.4%[33] lower in 2013 and 4.1% lower for 2014 than it would have been if no DOE inventory releases had occurred.

Looking forward, the price effect of DOE uranium inventory on the commercial market is expected to average $2.8/lb over the next ten years (2015-2024) for Scenario 1, as was discussed in Section 4.1. This results in an estimated long-term employment loss of 42 person years, meaning that future employment is reduced by 3.8%[34] on average as a result of the DOE inventory releases. Corresponding estimates for employment loss over the next ten years are 39 and 21 person-years for Scenarios 2 and 3, respectively, equivalent to 3.6% and 2.0% reductions relative to future employment if no DOE inventory releases take place.

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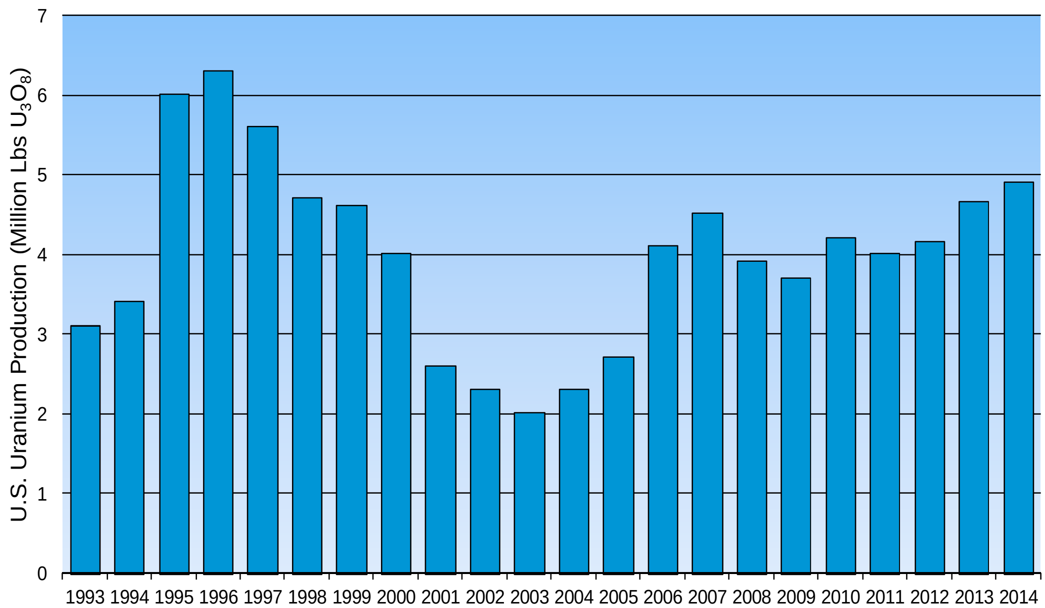
[32] The correlation is based on average price in the current and preceding year.

[33] Percentage calculated by comparing loss due to DOE (41) with 2013 actual employment (1156) plus DOE loss, or 41 / (1156+41) = .034 or 3.4%.

[34] Percentage calculated by comparing estimated loss due to DOE (43) with estimated 2015-2024 average employment before DOE loss (1,092), or 42 / (1092) = .038 or 3.8%.

U.S. Uranium Production

A history of U.S. uranium industry production is provided in Figure 4.9. Production has generally risen since the low of 2 million pounds in 2003. U.S. production has also risen since the start of the DOE uranium inventory barters in December 2009, with a noticeable increase taking place in 2013. Four new operations have started production since 2009 - Uranium One's Willow Creek in 2010, Uranium Energy Corporation (UEC)'s Hobson/Palangana in late 2010/early 2011, Ur-Energy's Lost Creek in 2013, and Uranerz's Nichols Ranch in 2014. One additional production center is now expected to start operations in 2015 - Peninsula's Lance.



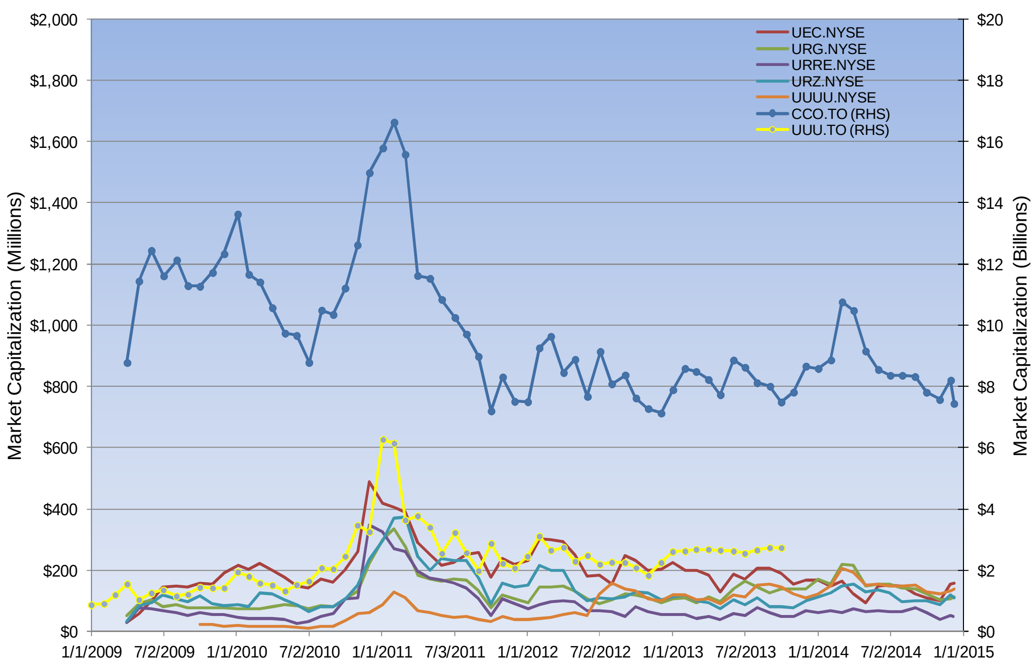
Source: U.S. Energy Information Administration, "Domestic Uranium Production Report" (4Q2014),(2013),(2002).

Figure 4.9 U.S. Uranium Industry Production, 1993 - 2014

Despite the overall increase in U.S. uranium production since 2009, the decline in prices has affected the actual and planned production of some U.S. operations. As noted in the April 2014 ERI market analysis, cut backs have taken place at Energy Fuels conventional mines and at Uranium One's Willow Creek and UEC's Palangana in-situ-leach (ISL) operations. Energy Fuels has subsequently decided to put the White Mesa mill on standby in early 2015. While mining at the Pinenut property will continue until depletion in early 2015, the ore will be stockpiled rather than milled. Cameco has halted new well field development at Crow Butte. While production at the Smith Ranch / Highland center expanded in 2014 with the operation of the North Butte satellite facility. In February 2015 Cameco announced its decision to halt new well field development at Smith Ranch / Highland due to market conditions. Total 2015 production at Cameco's U.S. sites may decline by 1 million pounds as a result. Mestena is believed to have halted well field development at its small ISL facility in Texas[35]. In mid 2014 both Ur-Energy and Uranerz announced they would limit production expansion at new ISL facilities at Lost Creek and Nichols Ranch rather than ramp up to originally planned production levels. The two companies decided to match production ramp up to existing term contracts rather than sell additional production at existing spot market prices. Despite the production cutbacks and reduction in initial ramp up rates, 2014 U.S. production was still 5% higher than 2013. U.S. Production in 2015 is now expected to decline back to 2012 levels or slightly lower, even though the Peninsula's Lance ISL project may start up in the second half of the year.

Market Capitalization

For the smaller mining companies in the U.S., most of which are publicly traded, market capitalization[36] is an important metric. Figure 4.10 displays the market capitalization history of companies[37] with U.S. production. Two of the companies, Cameco and Uranium One[38], are quite large with market capitalization in the billions, while the remaining companies are smaller with market capitalization in the millions. Two scales are therefore provided in the figure, with the larger companies using the right hand scale and the smaller companies using the left hand scale.



Source: www.ycharts.com

Figure 4.10 Market Capitalization of Companies with U.S. Production

[35] Little information is available on the privately held Mestena.

[36] Share price multiplied by number of outstanding shares.

[37] The companies are identified by their ticker symbols and stock market exchange in the figure.

[38] Uranium One was taken private in October 2014 when Russian mining company ARMZ completed the acquisition of all outstanding shares.

The data is compared on a relative basis, where each company's market capitalization in December 2009 equals 100, in Figure 4.11. Also provided in the figure are the spot and term market price indicators, which use the right hand scale. It is observed that the market capitalization of the smaller mining companies is sensitive to changes in the spot market price. During 2010, spot price increased from $40 per pound up to $70 per pound, an increase of 75%. The market capitalization of the smaller U.S. miners increased 150% to 600% in response. The response of a large mining company, Cameco, was restrained in comparison, with market capitalization increasing about 75%. Figure 4.11 shows that market capitalization declined just as rapidly following the Fukushima event. Market capitalizations have declined following the April 2014 ERI market analysis as the spot market price dropped below $30/lb for the May 2014 through July 2014 period and commodity stocks declined in general. While the uranium spot price subsequently increased starting in August and was $39/lb at the end of November 2014, the market capitalizations have been slow to respond.

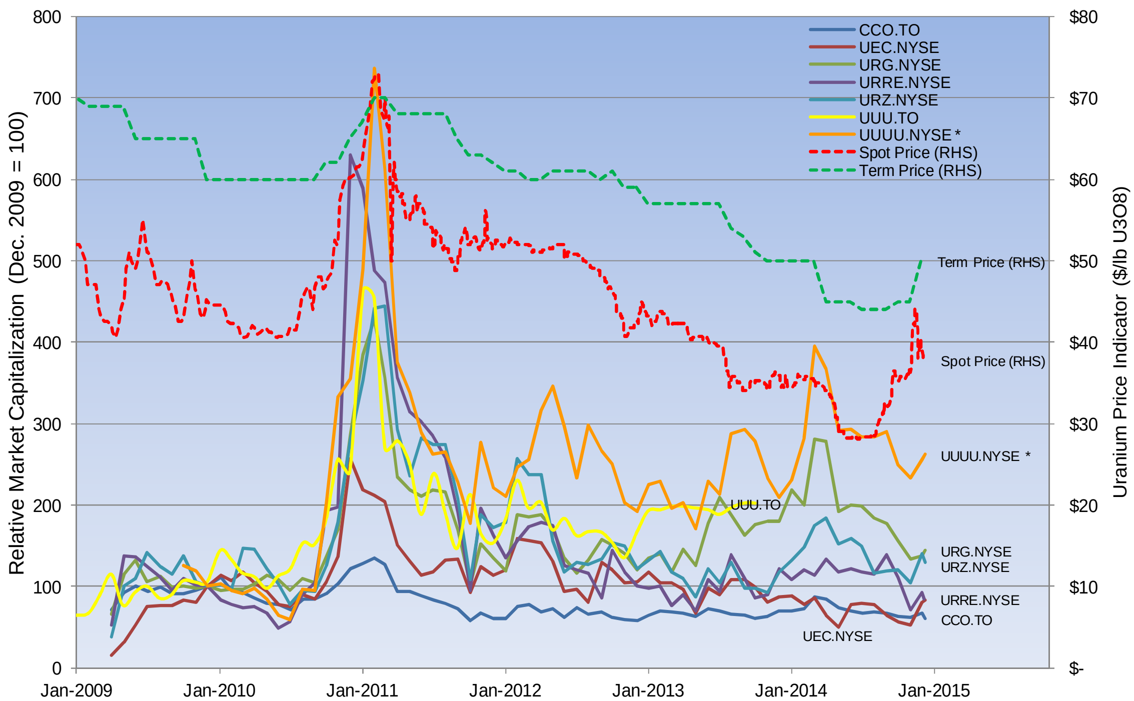


Figure 4.11 Market Capitalization -- Relative to December 2009

Market capitalization is an important metric for the smaller, publicly traded mining companies in the U.S. because it is representative of the ability of these companies to raise funds needed to move projects through the licensing process, which can take many years, as well as initial project development in some cases. The smaller companies generally do not have easy access to debt financing and are more dependent on equity financing. While the effect of large changes in the spot market price is obvious, the effect on market capitalization from the smaller price changes attributed to DOE inventory (See section 4.1) is not as clear.

Realized Prices and Production Costs

Revenues from U.S. uranium sales are obtained under a mix of term and spot market price based contracts. This is demonstrated by Figure 4.12, which compares the EIA's average delivered price in the U.S. with historical market prices. The figure shows that for U.S. end-users, the average price of all delivered uranium has increased steadily over the past ten years, before leveling off in 2012 and declining 5% in 2013 to \$52/lb-U_3O_8. A similar decline is expected by ERI for 2014. The EIA average delivered price in the U.S. is representative of realized prices for the uranium industry on a global basis.

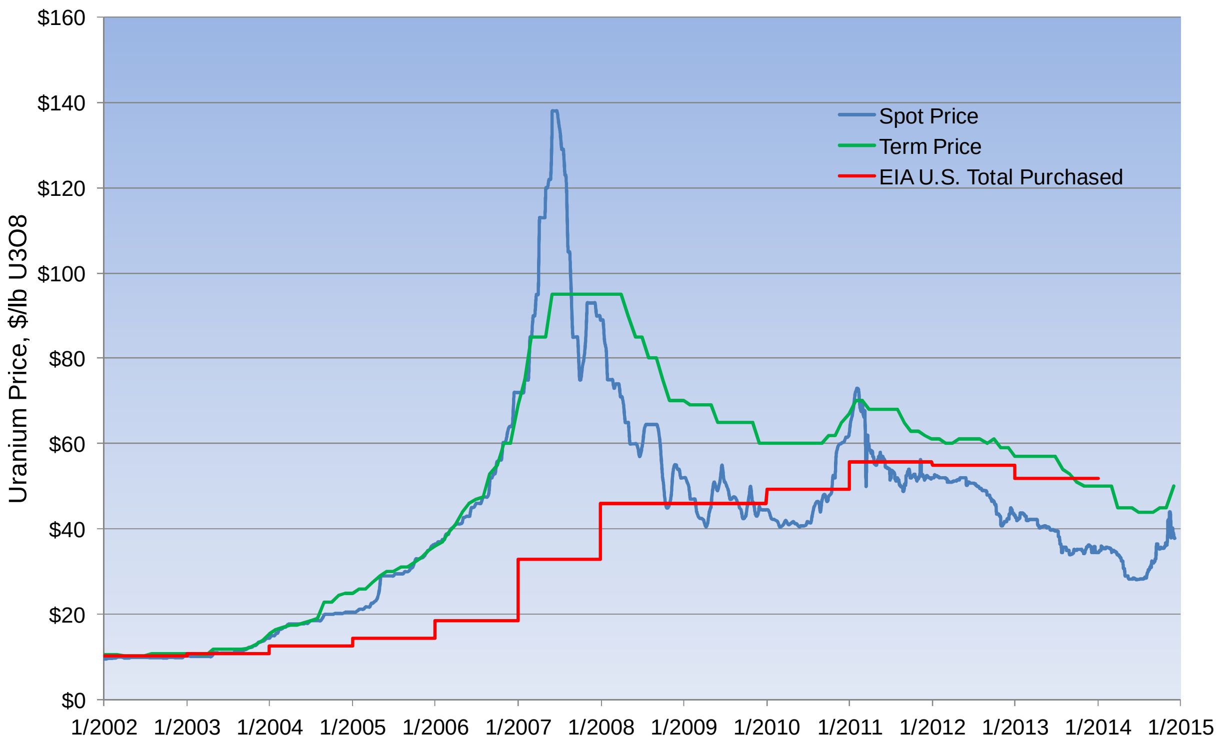


Figure 4.12 Market Prices and Average Delivered Price in the U.S.

Realized prices for the U.S. uranium supply industry varies from one company to another, as demonstrated by Figure 4.13 which presents the realized prices for companies with U.S. production during the period 2011 through the first three quarters of 2014. The prices are drawn from company public filings[39], and are compared to the average spot market price for each year. The companies providing price data represent approximately 95% of U.S. production in 2014. It is apparent that some mining companies have chosen to sell on a spot market price basis, while others have hedged their exposure to spot market prices by

[39] Note that Cameco's prices are for all production, not just the U.S. based production.

locking in prices using a base price escalated approach for a portion of their portfolio. For example, Cameco - the largest U.S. producer - has reported that it usually includes in its contracts a mix of fixed-price and market-price components, which reflect a target of 40% fixed-price and 60% market-price**.** Cameco's most recent estimate of the price sensitivity of its current contract portfolio indicates that the projected change in realized price is about 50% of the change in spot market price.[40] Less than 30% of U.S. production currently comes from companies that are effectively unhedged (no long-term contracts with higher fixed prices)[41].

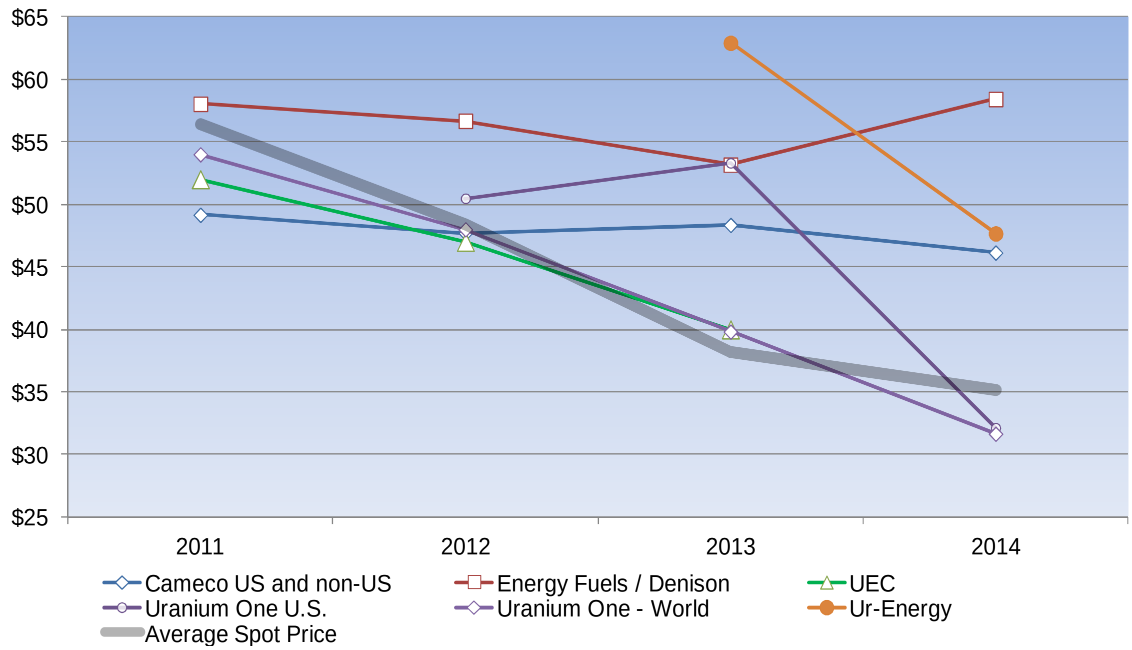


Figure 4.13 Realized Uranium Prices of Companies with U.S. Production

It is apparent that new U.S. uranium producers that have recently begun production have used fixed price term contracts to support the startup of their operations. Figure 4.14 shows that these companies agreed to such contracts when long-term prices were in the $55 to $70 per pound range. These contracts allowed the new operations to follow through on facility development even as prices have declined over the past two years. At least one of these companies has stated that the project would not have been able to proceed if the initial contracts had been made at current price levels ($45 to $50 per pound long-term). Owners of proposed new conventional mines outside the U.S. have typically stated that an incentive price of $60 to $70 per pound is required to move forward with development.

[40] Cameco Corporation in its February 10, 2014 "Management's Discussion and Analysis" that accompanied its financial statement and notes for the year ended December 31, 2013.
[41] Note that while Uranium One's realized price for U.S. production in 2013 was high, the realized prices for 2012 and 2014 are consistent with spot prices as are the prices for the company as whole, consistent with the stated policy to ensure that realized prices are highly correlated to the spot market price.

It does not appear that removing the DOE inventory from the market and adding back the $2 to $3 per pound price effect attributed to the DOE inventory material (shown in Table 4.1) would necessarily increase current prices enough to change the situation regarding the viability of new production centers in the U.S., that is, current spot prices would remain near $40 per pound and current term prices would remain near $50 per pound. Higher price signals appear to be required to move forward with the development of new conventional mines in the U.S. Lower cost ISL projects may still be able to move forward at current prices (which include the DOE inventory price effect). For example, in early December 2014 Peninsula announced a new term contract for its proposed Lance project, which it plans to start up in 2015. There have also been indications that the recent increase in spot prices to the $37 to $40/lb range may lead Ur-Energy to increase output at Lost Creek.

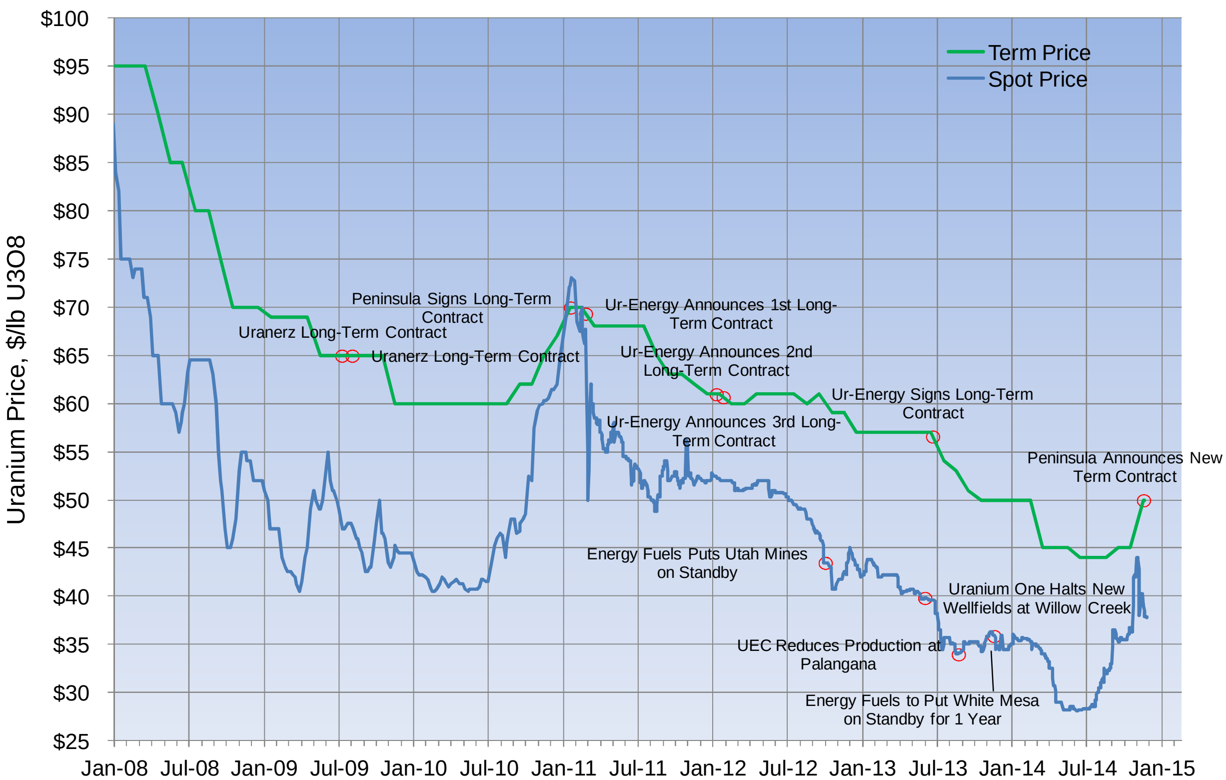


Figure 4.14 Market Prices and U.S. Industry Contracting and Production Events

Figure 4.14 also shows the price levels when announcements of cutbacks were made by some U.S. suppliers. Energy Fuels put its conventional mines in Utah on standby when spot prices dropped below $45 per pound. Uranium One and UEC cut back production activity at their ISL facilities when spot prices dropped below $40 per pound. Both of these suppliers are effectively unhedged and fully exposed to spot market prices. With spot prices in the $35 range, Energy Fuels announced its decision to place its remaining conventional mines still in operation and the White Mesa mill on standby for a year. Energy Fuels has long term contracts, some of which do not require the uranium to be sourced from Energy Fuels' mines, enabling the use of uranium purchased on the spot market at prices below production costs of Energy Fuels' conventional mines.

The EIA reports total industry expenditures for U.S. uranium production, including facility expense, in its annual Domestic Uranium Production Report. The total for 2013 was $168 million, or an average of $36 per pound when spread across 2013 uranium production of 4.66 million pounds. SEC standards require many U.S. mines to expense rather than capitalize mine and well field development costs. This results in higher initial production costs than would be obtained by depreciation of these assets over time. Figure 4.15 presents EIA production costs using a three year average to smooth them out. For example, the 2012 cost was obtained by dividing the sum of EIA production costs in 2011-2013 by the sum of EIA production over the same three year period). The figure indicates three-year average production costs rose steadily between 2004 and 2009, but have been fairly level since 2009 at about $40/lb. The U.S. production cost is consistent with the $40/lb global average production cost mentioned by other market analysts[42,43]. For comparison, the spot uranium price has recently[44] ranged between $37.00/lb and $39.10/lb .The EIA also reports exploration and development drilling costs. An estimate of the drilling costs devoted to development, based on feet drilled, indicates development drilling costs of $7/lb to $8/lb produced between 2009 and 2013.

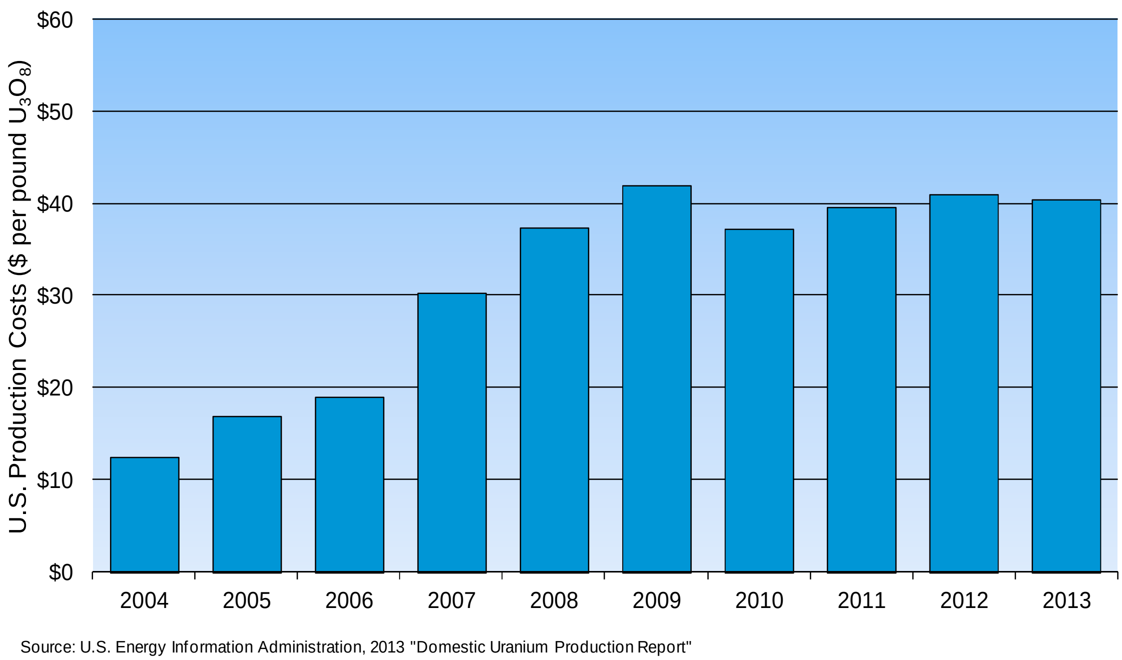


Figure 4.15 Three Year Average Production Costs for U.S. Uranium Industry

[42] Ux Consulting, Presentation by Nick Carter at the IAEA International Symposium on Uranium Raw Material for the Nuclear Fuel Cycle, June 27, 2014. 2013 production cost curve graphic stating "Over 120 million lbs available at $40 or less",

[43] Cantor Fitzgerald, Commodity Price Update, January 3, 2014. "... the spot price of US$34.50/lb is below the current marginal cost of production of US$40/lb..."

[44] Between November 30 and December 12, 2014

Production costs for U.S. ISL facilities are believed to range from the low $30s to mid $40s per pound. Some of the U.S. facilities employ contracting strategies which are immediately sensitive to changes in spot price. As a result, operations were cut back as prices declined to $40 per pound and below, which is consistent with the timing of decisions to cut back as shown in Figure 4.14.

The pattern of mine cutbacks shown earlier in Figure 4.14 as well as the domestic industry production costs just discussed do not seem to indicate that adding back the $3 per pound price effect attributed to all DOE inventory material for Scenario 1 (shown in Table 4.1) would move current prices enough to cause U.S. producers to ramp well field development and production activities back up. The resulting spot price level would remain near $40 per pound, still very close to average production costs, and may still not be sufficient for higher cost ISL producers to restart well field development or higher cost conventional mines to resume mining activities, and likely would not have prevented the decisions to cut back when prices declined to $35/lb in mid 2013 and then below $30/lb in mid 2014.

4.2.2 Potential Effect on the Domestic Conversion Services Industry

While DOE transfers would not displace already committed sales, a July 2012 presentation by a ConverDyn official noted that, as a result of plant closures in Japan and Germany following the March 2011 Fukushima accident in Japan, ConverDyn experienced a 25% loss of volume in sales.[45] World demand for conversion services associated with the loss of volume from Japan and Germany is estimated to be 9.5 million kgU of UF_6, or 15-16% decrease in total world conversion requirements. In the analysis described below, because there is only one uranium conversion facility in the U.S., the loss of sales/production volume for ConverDyn that is associated with the entry of DOE material into the conversion market can be assessed. In this analysis, ERI considers ConverDyn's reported 25% loss of volume associated with post-Fukushima losses in Japan and Germany.

Analysis of Sales Volume Effect

Conversion services (or UF_6) from all four of the world producers, as well as secondary market material from brokers and traders, make up U.S. supply. The conversion component may also be provided as part of enriched uranium product (EUP), whether from a fully integrated enricher or from an enricher underfeeding.

ConverDyn does not publish its annual production volumes of UF_6. However, in a declaration by a ConverDyn official in support of litigation against DOE (*ConverDyn v. U.S. DOE*) regarding the release of DOE inventory into the U.S. market,[46] ConverDyn

[45] Mani, Ganpat, President and CEO, ConverDyn, *Review of Study Supporting Accelerated DOE Inventory Sales and Transfers*, Nuclear Energy Institute, Nuclear Fuel Supply Forum, Washington, DC. July 31, 2012.
[46] Critchley, Malcolm, President and CEO, ConverDyn, Supplemental Declaration of Malcolm Critchley,

noted that over the past five years, its sales have ranged between 6.5 and 11 million kgU annually and Metropolis Works' production has been between 4.5 million and 11 million kgU annually. The maximum production of 11 million kgU annually is consistent with assumptions made in the April 2014 ERI market analysis, which analyzed two production levels for Metropolis Works - 10 million kgU and 12 million kgU annually. While the nameplate capacity of Metropolis Works is 15 million kgU as UF_6,[47] for the purposes of analyzing the potential loss of sales volume to ConverDyn associated with the introduction of DOE inventory into the market, ERI utilizes the maximum production of 11 million kgU at Metropolis Works based on the range of production over the past five years as reported by ConverDyn.[48] This capacity is assumed to be the annual production prior to ConverDyn's stated 25% loss of volume associated with customers in Germany and Japan following the Fukushima accident. Thus, assuming a 2010 production volume of 11 million kgU and a 25% loss of this volume, ConverDyn's current sales volume would be 8.25 million kgU.

In order to illustrate the effect on the conversion market associated with entry of DOE inventory, ERI analyzes the effect of the entry of planned DOE inventories totaling 3.04 million kgU in 2015 under Scenario 1, 2.19 million kgU in 2015 under Scenario 2, and 0.33 million kgU in 2014 under Scenario 3, as shown in Table 4.10. The quantities for Scenario 1 and Scenario 2 are indicative of the entry of planned DOE inventories over the next ten years for those scenarios. Under Scenario 1, the DOE inventory that will enter the market in 2015 includes: 0.65 million kgU from allocated down blended HEU, 2.06 million kgU associated with EM barter material to support GDP cleanup, 0.32 million kgU associated with down blended off-spec HEU previously transferred to TVA, and 0.015 kgU of off-spec non-UF_6 material. Under Scenario 2, the DOE inventory that will enter the market in 2015 includes: 0.45 million kgU from allocated down blended HEU, 1.41 million kgU associated with EM barter material to support GDP cleanup, 0.32 million kgU associated with down blended off-spec HEU previously transferred to TVA, and 0.02 kgU of off-spec non-UF_6 material. Under Scenario 3, the DOE inventory that will enter the market in 2015 includes: 0.32 million kgU associated with down blended off-spec HEU previously transferred to TVA, and 0.02 kgU of off-spec non-UF_6 material. For the purpose of this analysis, ERI assumes that 100% of the allocated down blended HEU, 100% of the material transferred to TVA, and 100% of the off-spec non-UF_6 will enter the U.S. market.

As noted in Section 3.2, Traxys purchases the UF_6 from FBP as part of it barter arrangement with EM (EM Barter material). According to Traxys, its goal in the sale of

ConverDyn, Plaintiff, v. Ernest J. Moniz, in his official capacity as Secretary of the U.S. Department of Energy and U.S. Department of Energy, Defendants, Case No. 1:14-cv-1012-RBW, United States District Court for the District of Columbia, Document 21-2, Filed July 14, 2014 (Critchley Declaration).

[47] Mani, Ganpat, ConverDyn, President and CEO, ConverDyn and Uranium Conversion, presented to the U.S. Nuclear Infrastructure Council, April 20, 2010; http://www.converdyn.com/press_room/pdf/presentations/US%20NIC%20Intro%20to%20CvD%20and%20Conv%20April%202010%20Final%20pdf.pdf

[48] Critchley Declaration Filed July 14, 2014, at 10.

the EM Barter material it to sell at least 50% of the material to non-U.S. customers. It should be noted that Traxys has reported that in 2013, an estimated 1 million kgU of the conversion component of the EM Barter material was delivered to U.S. utilities, or approximately 42% of conversion component in the EM Barter material.[49] Since there is no guarantee that this same percentage of sales of EM Barter material will be made in later years, in this analysis, ERI conservatively assumes that 50% of the EM barter material enters the U.S. market and 50% enters the remaining world market in 2015 and beyond, as stated by Traxys as its goal. Under Scenario 1, out of the total of 3.04 million kgU of DOE inventory expected to affect the market in 2014, an estimated 2 million kgU, or 66% is expected to be sold into the U.S. market and 1.03 million kgU, or 34% is expected to be sold into the remaining world market as summarized in Table 4.10. Under Scenario 2, a total of 1.48 million kgU (68%) is expected to affect the U.S. market and 0.71 million kgU, or 32% is expected to be sold into the remaining world market. Under Scenario 3, ERI conservatively assumes that the entire 0.33 million kgU is expected to be sold into the U.S. market.

[49] Smith, Kevin P., Traxys North America LLC, Managing Director for Uranium Marketing and Trading, Declaration of Kevin P. Smith, Attachment 6 to Defendant's Opposition to Plaintiff's Motion for Preliminary Injunction, Case No. 1:14-cv-1012-RBW, Document 17-7, Filed July 7, 2014, at 7-12.

Material Description	Scenario 1				
	2015 Quantity (Million	Volume to U.S. Market		Remaining Volume to World	
		%	Quantity	%	Quantity
Allocated HEU Downblend	0.65	100%	0.65	0%	0.00
EM Barters for GDP Cleanup	2.06	50%	1.03	50%	1.03
Off-Spec HEU Downblend - TVA	0.32	100%	0.32	0%	0.00
Off-Spec Non-UF_6	0.02	100%	0.02	0%	0.00
Total	3.04	66%	2.01	34%	1.03
	Scenario 2				
Allocated HEU Downblend	0.45	100%	0.45	0%	0.00
EM Barters for GDP Cleanup	1.41	50%	0.71	50%	0.71
Off-Spec HEU Downblend - TVA	0.32	100%	0.32	0%	0.00
Off-Spec Non-UF_6	0.02	100%	0.02	0%	0.00
Total	2.19	68%	1.48	32%	0.71
	Scenario 3				
Allocated HEU Downblend	0.00	100%	0.00	0%	0.00
EM Barters for GDP Cleanup	0.00	50%	0.00	50%	0.00
Off-Spec HEU Downblend - TVA	0.32	100%	0.32	0%	0.00
Off-Spec Non-UF_6	0.02	100%	0.02	0%	0.00
Total	0.33	100%	0.33	0%	0.00

NOTE: Numbers may not add exactly due to rounding.

Table 4.10 Summary of DOE Inventory Expected to Affect the Conversion Market in 2014

As shown in Table 4.11, world requirements for natural uranium as UF_6 in 2010 were approximately 60.3 million kgU. In 2010, U.S. requirements were 19.2 million kgU and requirements in Japan and Germany were 7 million kgU and 2.5 million kgU, respectively. Requirements in China and Russia in 2010 were 3.9 million kgU and 6.7 million kgU respectively. According to ConverDyn statements, it does not have access to the markets in Russia and China. If natural uranium requirements for Russia/CIS and China are removed from total world requirements, the remaining world requirements in 2010 were 49.7 million kgU. Total world demand for natural uranium in 2015 and 2016 is estimated to average 58.4 million kgU annually. Taking into account the reduced demand for uranium in Germany (1.5 million kgU) and Japan (0 kgU), the remaining world requirements in 2015 and 2016 are estimated to be an average of 41.2 million kgU annually. U.S. requirements in 2015 and 2016 are estimated to average 18 million kgU annually.

Regional Market	2010	2015-2016 Average Annual Requirements
World	60.3	58.4
U.S.	19.2	18.0
Japan	7.0	0.0
Germany	2.5	1.5
China	3.9	8.0
Russia/CIS	6.7	9.2
Remaining World - Russia/CIS & China	49.7	41.2

Table 4.11 World and Regional Requirements for Natural Uranium (UF_6) in 2010 and 2015-2016

In the past, ConverDyn has not published information regarding its share of the world market for conversion services (U.S., Europe, Asia, etc.) In the April 2014 ERI market analysis, ERI determined that ConverDyn had an estimated 25% share of the U.S. market for conversion services. In a declaration in ***ConverDyn v. U.S. DOE***, ConverDyn noted that its share of U.S. demand was 25%.[50] While the April 2014 ERI market analysis also examined a higher, 30% U.S. market share for ConverDyn, in this analysis ERI will utilize ConverDyn's stated U.S. market share of 25%. Assuming a 25% ConverDyn share in U.S. market results in a U.S. sales volume of 4.5 million kgU (18 million kgU * 25%) in 2015. If ConverDyn’s 2015 sales volume is 8.3 million kgU (assuming a 25% loss of sales on pre-Fukushima volume of 11 million kgU), this means that 3.8 million kgU are allocated to the remaining world market minus the U.S. market (41.2 million kgU – 18 million kgU), or an estimated 16% market share as shown in Table 4.12.

Applying ConverDyn’s U.S. market share of 25% and the remaining world market share of 16% to the volume of DOE inventory expected to be introduced into the market in 2015 from Table 4.11, results in a volume effect of 0.5 million kgU in the U.S. market and 0.2 million kgU effect in the remaining world market for a total of 0.7 million kgU. As discussed above, assuming that ConverDyn’s post-Fukushima sales volume is 8.3 million kgU, ConverDyn’s market volume without the introduction of DOE inventory to the market

[50] Critchley, Malcolm, President and CEO, ConverDyn, Declaration of Malcolm Critchley, ConverDyn, Plaintiff, v. Ernest J. Moniz, in his official capacity as Secretary of the U.S. Department of Energy and U.S. Department of Energy, Defendants, Case No. 1:14-cv-1012-RBW, United States District Court for the District of Columbia, Document 7-3, Filed June 23, 2014.

would be 8.9 million kgU as UF_6 as shown in Table 4.12. Since the volume of DOE material entering the market in Scenario 1 is similar in volume to the quantity of DOE material that entered the market annually during the past several years, this analysis assumes that the Scenario 1 "ConverDyn Volume, Without DOE Inventory", or 8.9 million kgU annually, is the baseline ConverDyn Volume for the purpose of calculating ConverDyn Volumes "With DOE Inventory" for Scenarios 2 and 3. That is, because the DOE inventory volumes that would enter the market in Scenarios 2 and 3 are lower than that for Scenario 1, ConverDyn's sales volume With DOE Inventory would be higher than the Scenario 1 volume, as shown in Table 4.12.

Converdyn Market Share Assumption	Converdyn Share of Market Share		Market Volume Impact to Converdyn (million kgU)			Converdyn Volume (million kgU)	
	US	Remaining World (1)	US	Remaining World	Total	With DOE Inventory	Without DOE Inventory
	%	%					
Scenario 1 (2)	25%	16%	0.5	0.2	0.7	8.3	8.9
Scenario 2	26%	16%	0.4	0.1	0.5	8.4	8.9
Scenario 3	27%	17%	0.1	0.0	0.1	8.8	8.9

Note (1): For purposes of the calculation of Converdyn's share of World market, ERI assumes World Market of 41.2 million kgU as UF6 (World market minus Russia/CIS and China)

Note (2) : In Scenario 1, U.S. market share of 25% is based on statements by ConverDyn officials. Calculations assume pre-Fukushima market volume of 11 million kgU for Converdyn, and post-Fukushima volume of 8.3 million kgU (25% loss of volume according to Converdyn statements). Remaining World Market Share (minus Russia/CIS and China requirements) =[8.3 - (4.5 m kgU = US market)] / [41.2 (World Market - Russia/China) - 18 (US market)]

Note (3): In Scenarios 2 and 3, due to removal of DOE inventory from the U.S. and World markets compared to the volumes assumed in Scenario 1, ConverDyn's percent of US and Remaining World markets is somewhat higher than in Scenario 1. This assumes that ConverDyn secures a portion of sales associated with the lower DOE inventory volumes entering the market in Scenario 2 and 3.

Note (4): Totals may not add exactly due to rounding.

Table 4.12 Effect on ConverDyn Market Volume Associated with Introduction of DOE Inventory into the Market in 2015, Assuming Pre-Fukushima Sales Volume of 11 Million kgU as UF_6

In Scenario 2, DOE inventory entering the market is 0.9 million kgU less than Scenario 1 (0.5 million kgU less in the U.S. market and 0.3 million kgU less in the remaining world market). Assuming that ConverDyn captures similar market share of this additional material (25% of additional U.S. material and 16% of additional Remaining World material), results in a 26% U.S. market share and a 16% Remaining World market share. Applying the Scenario 2 ConverDyn U.S. market share (26%) and the Remaining World market share (16%) to the volume of DOE inventory expected to be introduced into the market in 2015 from Table 4.11, results in a volume effect of 0.4 million kgU in the U.S. market and 0.1 million kgU effect in the remaining world market for a total of 0.5 million kgU. As discussed above, assuming that ConverDyn's sales volume Without DOE Inventory is 8.9 million kgU, results in a calculated ConverDyn sales volume With DOE Inventory of 8.4 million kgU for Scenario 2.

A similar calculation was conducted for the volumes of DOE material entering the market in 2015 under Scenario 3 in order to calculate ConverDyn's effective market shares – 27% of U.S. market and 17% of Remaining World market. Applying these percentages to the volume of DOE inventory expected to be introduced into the market in 2015 for Scenario 3 from Table 4.11, results in a volume effect of 0.1 million kgU in the U.S. market. As discussed above, assuming that ConverDyn's sales volume Without DOE Inventory is 8.9 million kgU, results in a calculated ConverDyn sales volume With DOE Inventory of 8.8 million kgU for Scenario 3.

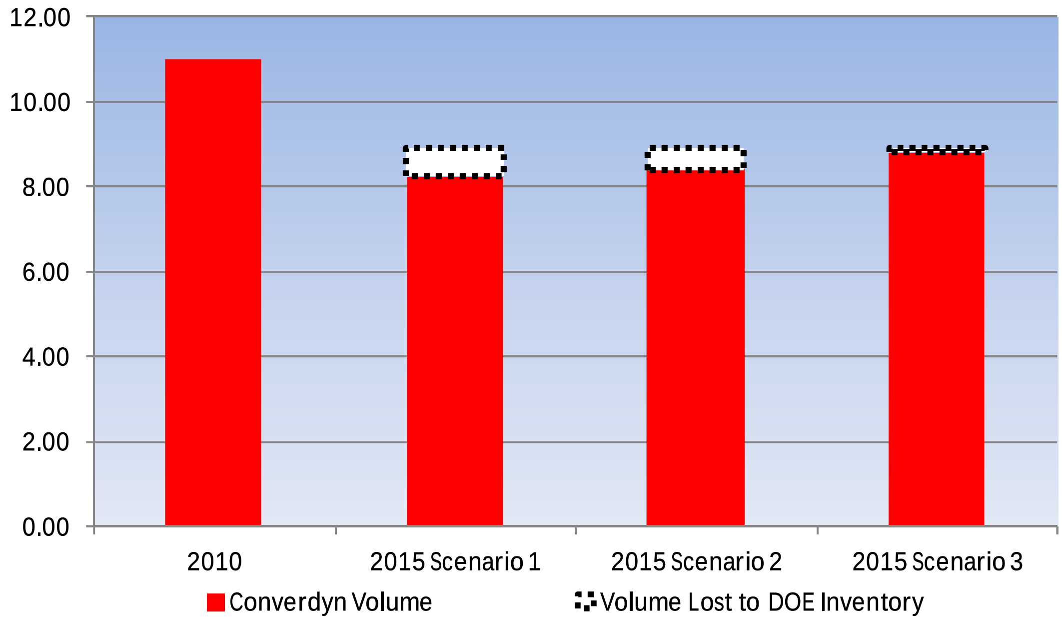


Figure 4.16 Estimated ConverDyn Sales Volume in 2010 and Scenario 1, 2 and 3 in 2015, Volume Effect of DOE Sales in 2015 Assuming Pre-Fukushima Sales Volume of 11 Million kgU as UF_6

As shown in Figure 4.16, in Scenario 1, assuming that ConverDyn's pre-Fukushima sales volume of 11 million kgU as UF_6 and its U.S. market share is 25%, the introduction of DOE inventory into the conversion market results in a volume effect of 8% in Scenario 1. As noted above, in Scenarios 2 and 3, this analysis assumes that ConverDyn's sales volume without DOE inventory is equal to that calculated for Scenario 1 – 8.9 million kgU per year. The introduction of DOE inventory into the conversion market results in a volume effect of 6% in Scenario 2 and 1% in Scenario 3.

As shown in Table 4.10, the quantity of DOE inventory expected to affect the commercial market in 2015 and over the next several years is 3.04 million kgU or less annually under Scenario 1. Total secondary market supplies in 2015 are expected to be approximately 16.5 million kgU. As discussed in more detail in Section 4.3.2, ConverDyn's sales volume is also affected by the presence of these other market factors, including other secondary market supply sources. However, this report only assesses the effect of DOE inventory on U.S. conversion sales volume.

Analysis of Effect on Production Cost for Conversion Services

As analyzed above, ERI calculates that the volume effect to ConverDyn would be 0.7 million kgU under Scenario 1, 0.5 million kgU under Scenario 2, and 0.1 million kgU under Scenario 3, assuming that ConverDyn's pre-Fukushima volume was 11 million kgU. In order to analyze the effect of this decrease in sales volume on the unit cost of production, it is necessary to make assumptions regarding the percent of production costs that are fixed and variable. Conversion facilities have high fixed costs, so ERI analyzed two scenarios assuming 80% and 100% fixed costs in order to determine the effect on production costs on a $/kgU basis.

Honeywell reports that Metropolis Works has lost more than $100 million over the past decade.[51] While ConverDyn's realized price is believed to have increased over that period, unit costs have gone up as well. As shown in Table 4.12, assuming a post-Fukushima production volume of 8.3 million kgU, if DOE inventory was not introduced into the market, the volume in 2015 would be 8.9 million kgU. If the effective production cost to produce 8.9 million kgU is $15.0 per KgU, with a sales price is $14.0/kgU (because the Metropolis Works is operating at a loss), the total sales revenue would be $125 million and production costs would be $134 million - a loss of $9 million for a ConverDyn sales volume of 8.9 million kgU.. Under Scenario 1, if 100% of the costs are fixed costs, then if Metropolis Works is only producing 8.3 million kgU, the fixed costs to produce this material would still be $134 million, but the unit production costs would increase to $16.1/kgU, or 7% under Scenario 1, to $15.9/kgU to produce 8.4 million kgU under Scenario 2, or 6% increase, and to $15.2/kgU to produce 8.8 million kgU under Scenario 3, or 1% unit cost increase in 2015.

As shown in Table 4.13, under Scenario 1, if fixed costs were 80% of the cost of production, a reduction of production volume from 8.9 to 8.3 million kgU would result in an increased cost of production of $0.9 per kgU as UF_6. A production volume of 8.9 million kgU would have fixed costs of $107 million and variable costs of $27 million, with total costs of $134 million or $15.0 per kgU. A production volume of 8.3 million kgU would have fixed costs of $107 million (the same as the 8.9 million kgU production) and variable costs of $25 million for total production costs of $132 million or $15.9 per kgU. Thus there would be an approximate $1/kgU or 6% increase in production costs.

Similarly, under Scenario 2, a reduction in sales volume from 8.9 million kgU to 8.4 million kgU would result in increased production costs of $0.7/kgU or a 5% increase. Under Scenario 3, a reduction in sales volume from 8.9 million kgU to 8.8 million kgU would result in increased production costs of $0.1/kgU or a 1% increase as shown in Table 4.13.

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[51] Pritchett, Jim, Plant Manager, Metropolis Works, Honeywell, Letter to Metropolis Works Colleagues, December 31, 2013.
http://www.honeywell-metropolisworks.com/?document=letter-to-employees-2&download=1

		Fixed Cost	Variable Cost	Total Cost of Production	Unit Cost ($/kgU)
Scenario 1					
		80%	20%		
Production Cost Components		$ 12.00	$ 3.00		$ 15.00
Production Volume		Production Costs ($ Millions)			
- without DOE sales	8.9	$ 106.8	$ 26.7	$ 133.5	$ 15.00
- with DOE sales	8.3	$ 106.8	$ 24.9	$ 131.7	$ 15.90
Increased production cost					$ 0.90
Scenario 2					
		80%	20%		
Production Cost Components		$ 12.00	$ 3.00		$ 15.00
Production Volume		Production Costs ($ Millions)			
- without DOE sales	8.9	$ 106.8	$ 26.7	$ 133.5	$ 15.00
- with DOE sales	8.4	$ 106.8	$ 25.2	$ 132.0	$ 15.70
Increased production cost					$ 0.70
Scenario 3					
		80%	20%		
Production Cost Components		$ 12.00	$ 3.00		$ 15.00
Production Volume		Production Costs ($ Millions)			
- without DOE sales	8.9	$ 106.8	$ 26.7	$ 133.5	$ 15.00
- with DOE sales	8.8	$ 106.8	$ 26.4	$ 133.2	$ 15.10
Increased production cost					$ 0.10

Note: Numbers may not add exactly due to rounding.

Table 4.13 Change in Production Cost for UF_6 Due to Decrease Volume Associated with Introduction of DOE Inventory into Market

Thus, depending upon the percentage of production costs that are fixed (80% to 100%), under Scenario 1, production costs would increase by 6% (80% fixed costs) to 7% (100% fixed costs); Scenario 2 production costs would increase by 5% to 6%; and Scenario 3 production costs would increase by 1%. The production cost increase of an estimated 1% to 7% would be in addition to the decrease in market clearing prices associated with the introduction of the DOE inventory into the market as discussed in Section 4.1.

Reduction in Workforce Associated with Volume Reduction

The April 2014 ERI market analysis discussed the decrease in staffing levels that occurred at Metropolis works when the plant restarted in Summer 2013 after an extended shutdown -

with total staffing of approximately 270 employees.[52] According to Metropolis Works management, the staffing levels would be lower than in the past to reflect "current market demand and UF_6 volumes required by our customers." Prior to the 2012-2013 temporary shutdown of Metropolis Works for seismic upgrades, the work force was approximately 334.[53] Therefore, the 270 employees that would staff the plant after it returned to production in 2013 were 80% of the pre-shutdown workforce. Based on these figures, there is some correlation of work force size to long-term production volume – thus it is unlikely that 100% of the cost of production at Metropolis Works is fixed. The cost of fluorine is variable as well.

As noted in a 2012 ConverDyn paper by ConverDyn[54], ConverDyn experienced a 25% reduction in sales volume associated with the loss of customer demand in Germany and Japan following the Fukushima accident. If ConverDyn's pre-Fukushima sales volume was 11 million kgU annually, this would be a loss of volume of 2.75 million kgU annually. This compares to the relatively small volume reduction effect to ConverDyn associated with DOE sales of 0.1 to 0.67 million kgU as shown in Table 4.12 discussed above – under Scenario 1 this is an estimated 24% of the volume loss to ConverDyn associated with the shutdown of nuclear power plants in Japan and Germany. Under Scenario 2 it is an estimated 17% of the post-Fukushima volume loss and under Scenario 3, an estimated 4%. A portion of the reduction in work force at ConverDyn may be associated with the introduction of DOE inventory into the market. However other secondary supply sources such as enricher underfeeding, upgrade of tails in Russia, and Russian HEU feed were also factors in ConverDyn's volume reduction.

As noted in the April 2014 ERI market analysis, it is also recognized that the greater the amount of secondary supply that is available to owners and operators of nuclear power plants to meet their operating requirements, particularly at the lower spot market prices, would have the potential of reducing contracting volumes under the higher priced term contracts. As was the case for all of the markets, term contracting was in fact lower during 2013 and 2014. One might also expect that this would lead to the decline in term market price but it has held fairly steady over the past 18 months.

4.2.3 Potential Effect on the Domestic Enrichment Services Industry

As discussed in Section 2, the enrichment market remains in an oversupply situation. There are two U.S.-based enrichment suppliers – Urenco and Centrus (formerly USEC Inc.). As shown in Table 3.8, the total equivalent net million SWU that will enter the

[52] Smith, Larry, Plant Manager, Metropolis Works, Honeywell, Letter to Employees, April 15, 2013. http://www.honeywell-metropolisworks.com/?document=apr-15-2013-letter-to-employees-3&download=1

[53] Smith, Larry, Plant Manager, Metropolis Works, Honeywell, Letter to Employees, July 19, 2012. http://www.honeywell-metropolisworks.com/?document=jul-19-2012-letter-to-employees&download=1

[54] Critchley, Malcolm, Chris Frankland and Ganpat Mani, ConverDyn, *Review of the ERI Study used to Support the May 15, 2012 DOE Secretarial Determination for the Sale or Transfer of Uranium*, June 2012,

market due to transfers of DOE inventory average 0.85 million SWU per year over the period 2015 to 2024 under Scenario 1, 0.82 million SWU per year under Scenario 2 and 0.4 million SWU per year under Scenario 3. SWU requirements in the U.S. over the period 2015 - 2024 average 14.8 million SWU per year. DOE inventory that will enter the U.S. enrichment market during this period represents 6% of total U.S. requirements under Scenario 1 and 2, and 3% under Scenario 3. DOE inventory would be 2% of world requirements under Scenario 1 and 2 and 1% under Scenario 3 during the period 2015 to 2024.

Centrus no longer produces enriched uranium - its future sales will come from current inventory, SWU purchased from other suppliers and SWU purchased under a Transitional Supply Agreement between Centrus and TENEX. Centrus is only able to deliver limited quantities of the SWU purchased from Russia into the U.S. market – the rest must be delivered to non-U.S. customers. In its 2013 10-K report[55], USEC noted that due to its fixed commitment to purchase Russian LEU under the Transitional Supply Agreement with TENEX, any reduction in purchases by the customers below the level required for the company to resell both its inventory and the Russian material could adversely affect revenues, cash flows and results of operations.

In its 2013 Annual Report, Urenco states that its order book as of December 31, 2013, was in excess of €17 billion, approximately €1 billion less than 2012 order. The 2013 Annual Report notes that the reduction in order book value due to deliveries made to customers was "partially offset by new agreed business, and a revaluation of US dollar elements in contracts in line with the recent euro/dollar exchange rate movements."[56]

As noted in Section 2.3, and shown in Figure 2.8, total world enrichment supply significantly exceeds projected requirements through 2023. Introduction of DOE inventory into the SWU market is estimated to lower prices by 4% in both the spot market and term markets. While the current market is one of oversupply due to reduced near-term demand, 95% of enrichment services and/or EUP are sold under long-term contracts. However, as discussed in Section 2.3, with the current over-supplied enrichment market both the term and spot market prices have declined considerably. The price decline in the past three and a half years following Fukushima has been considerable at –43% in both the term and spot markets.

In the past, there was a benefit to USEC in 2012 and 2013 that allowed the continued operation of the Paducah Gaseous Diffusion Plant (PGDP) for an additional 12 months in order to enrich the higher assay depleted UF_6 that was transferred to ENW. The enrichment content of the resulting LEU will be used by TVA under a term contract with ENW. The historic DOE transfers of BLEU materials containing equivalent enrichment services to TVA have been known to the market for many years and are long-term contracts in nature.

[55] USEC, Form 10-K, Annual Report For the fiscal year ended December 31, 2013.

[56] Urenco, Limited, 2013 Annual Report,

The enrichment industry has the ability to lessen the effect of oversupply by underfeeding its plants to make use of the excess supply. Urenco has estimated that it is now using 10% to 15% of its capacity for underfeeding or re-enriching DUF_6. The revenue generated by the subsequent sales of natural UF_6 can be significant when such a large fraction of capacity is used for underfeeding, although still less than normal commercial sales of enrichment services (if the customer demand was present).

4.3 Additional Nuclear Fuel Market Considerations

4.3.1 Price Volatility

The level of price volatility in the uranium, conversion and enrichment markets may be useful when judging the importance of the price effects attributed to DOE material. Figure 4.17 examines the historical price volatility in each of the spot markets as measured by change in market price on a rolling 12 month basis. For example the 12 month change in uranium spot market price for November 30, 2014 is 9%, found by comparing the November 30, 2014 price of $39.00/lb to the November 30, 2013 price of $35.90/lb. Figure 4.17 demonstrates the considerable price volatility which occurred in the uranium and conversion spot markets over the past ten years. Spot enrichment prices have been much less volatile in comparison. By this measure, the spot markets for uranium and conversion have been less volatile over the past year than has been observed for much of the last ten years. The spot market price volatilities have tended to be much larger than the negative price effect of the DOE material, which averaged -7% for uranium, -10% for conversion and -4% for enrichment between 2012 and 2014[57]. The relatively modest spot price volatility demonstrated over the past year is expected to continue, but past history shows higher volatility always remains a possibility.

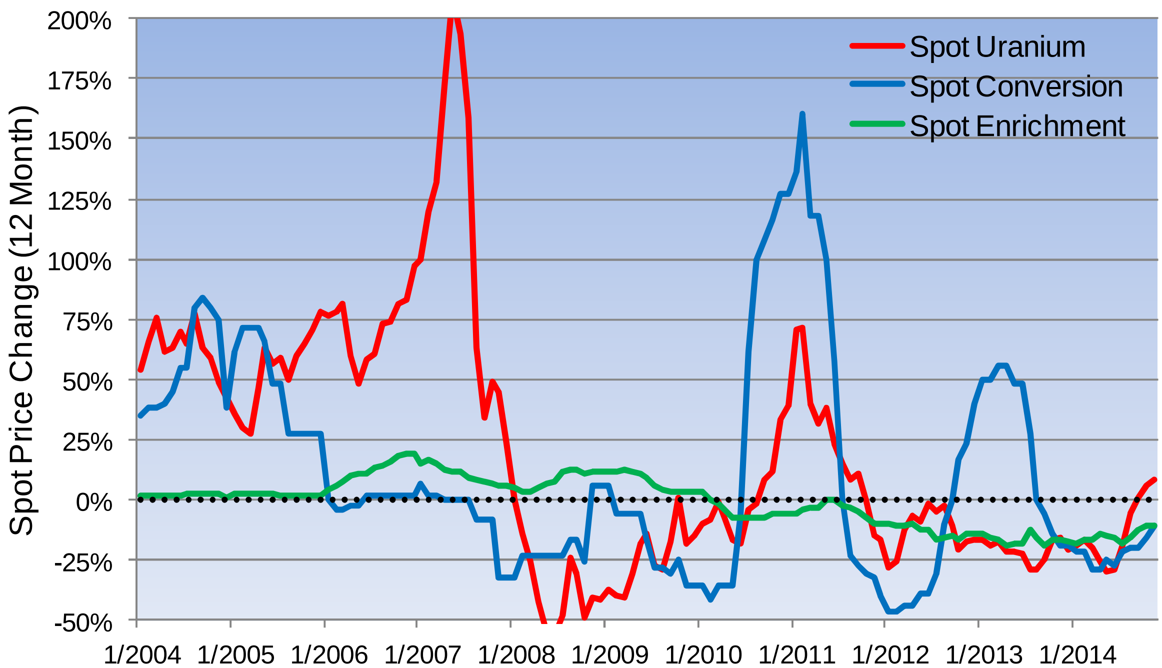

Figure 4.17 Spot Market 12 Month Price Changes

[57] For example, DOE uranium price impact averages $2.8/lb over 2013-2014, spot uranium price averaged $39.77/lb, so price change is -$2.8 / ($2.8+$39.77) = -.066 or -7%.

Figure 4.18 examines the historical price volatility in each of the term markets as measured by change in market price on a rolling 12 month basis. A comparison of Figures 4.17 and 4.18 shows that the term markets demonstrate much less price volatility than do the spot markets. As was the case with the spot market prices, the uranium and conversion term markets have demonstrated more volatility than the enrichment term market over the past ten years, although the conversion term market has little volatility over the past two years. The term market price volatilities have tended to be much larger than the negative price effect of the DOE material, which averaged -5% for uranium, -5% for conversion and -3% for enrichment between 2012 and 2014[58]. The relatively modest term price volatility demonstrated over the past year is expected to continue, with even less volatility in the enrichment term market, but past history shows that higher volatility always remains a possibility.

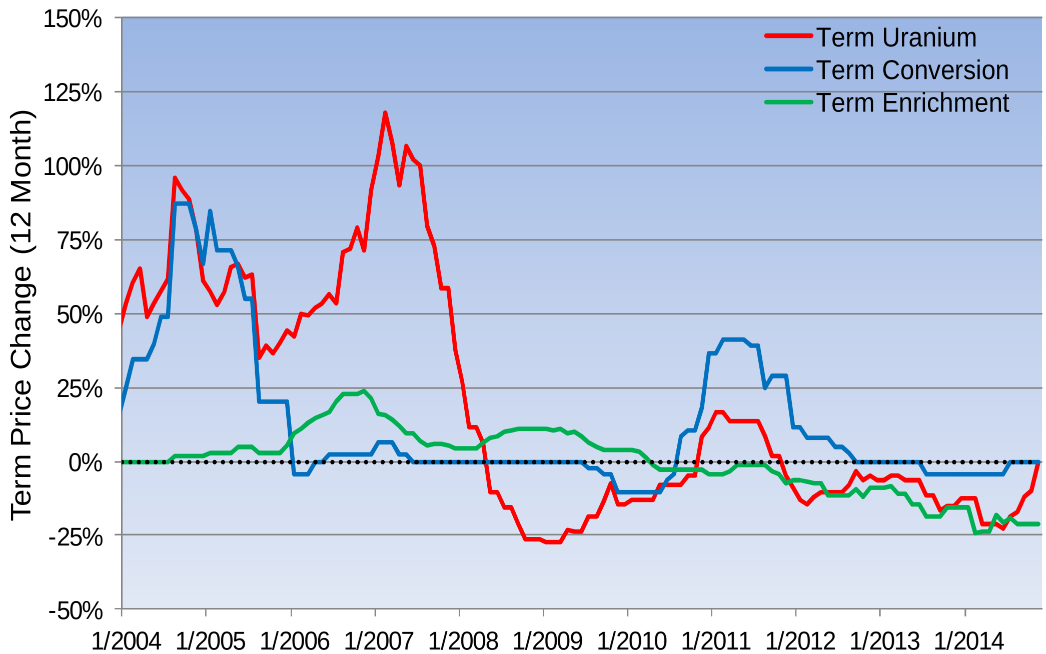

Figure 4.18 Term Market 12 Month Price Changes

The statistical measure of price volatility[59] on an annualized basis is provided for each of the spot markets in Figure 4.19 and for each of the term markets in Figure 4.20. The same general conclusions are reached: price volatility is noticeably higher for the uranium and conversion markets than for the enrichment market, although conversion term price volatility has been low in recent years.

[58] For example, DOE uranium price impact averages $2.8/lb over 2013-2014, term uranium price averaged $50.35/lb, so price change is -$2.8 / ($2.8+$50.35) = -.053 or -5%.

[59] Based on the financial definition of volatility as a measure of variability in price over time (e.g. stock price volatility). Calculated from the annualized standard deviation of monthly changes in price.

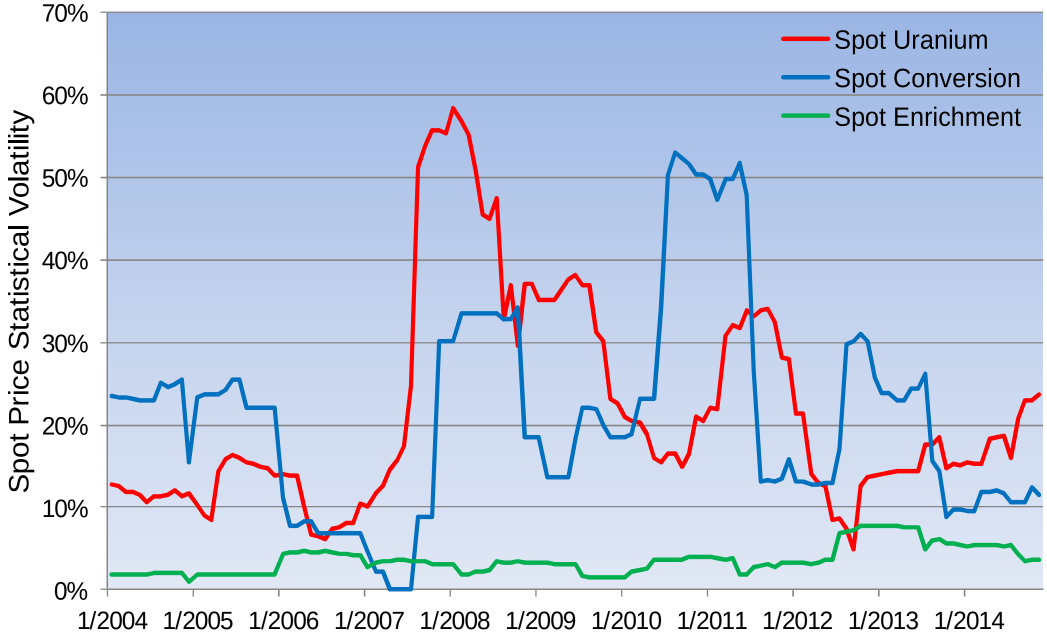

Figure 4.19 Spot Market Statistical Price Volatility

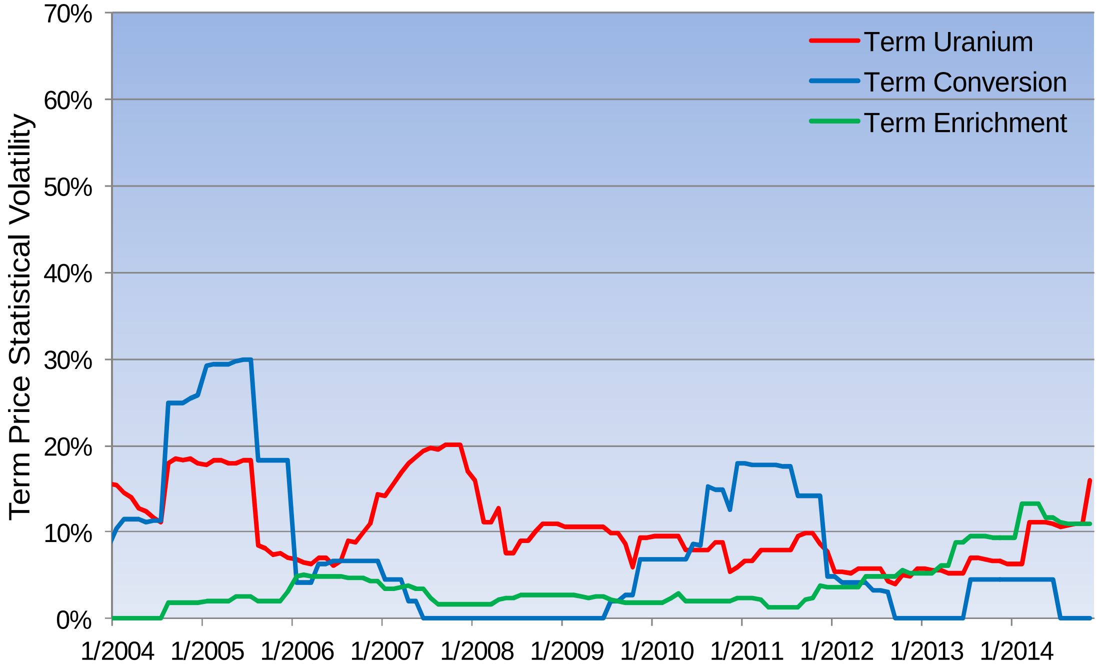

Figure 4.20 Term Market Statistical Price Volatility

4.3.2 DOE Inventory Relative to Other Market Factors

DOE Inventory Relative to Total Market Supply

To help judge the DOE inventories role in the total uranium market, Figure 4.21 compares the Scenario 1 DOE quantities that have or are expected to affect the uranium market to total uranium market supply, where the supply is broken down between primary production and secondary supply. Total market supply, including the DOE material, averaged 204 million pounds U_3O_8 in 2012 and 2013, is expected to decrease to 188 million pounds U_3O_8 in 2013 and 2014, and then gradually increase to an average of 211 million pounds U_3O_8 between 2018 and 2020.

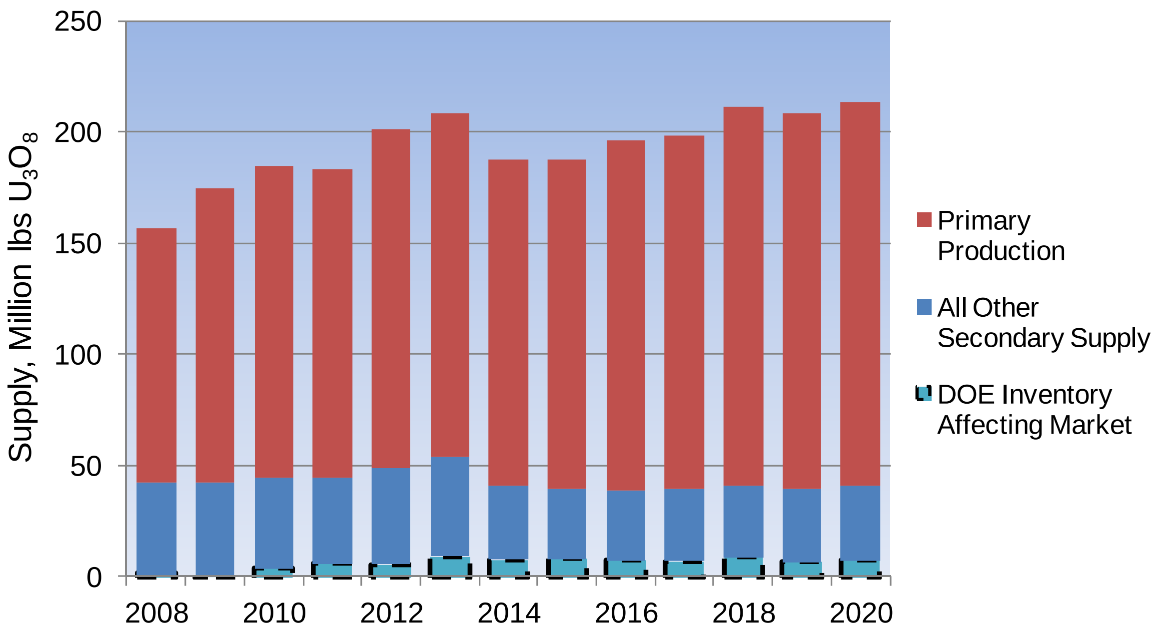

Figure 4.21 Scenario 1 DOE Inventory Relative to Total Uranium Market Supply

Figure 4.22 compares the DOE inventory's share of total uranium market supply on a percentage basis for the three scenarios. The DOE inventory's share of total uranium market supply has grown from about 1% in 2008 and 2009 to 4.3% for 2013 and 2014. A slight decline to 3.8% over the next three years (2015-2017) is projected for Scenario 1. A larger decline is projected for the next three years under Scenarios 2 and 3, where DOE inventories are projected to average 2.7% and 0.2% of total uranium market supply, respectively. The supply shares for Scenarios 2 and 3 will then start to rise, however, and Scenario 2 will average 4.3% in 2019 and 2020, which is higher than the 3.3% of Scenario 1.

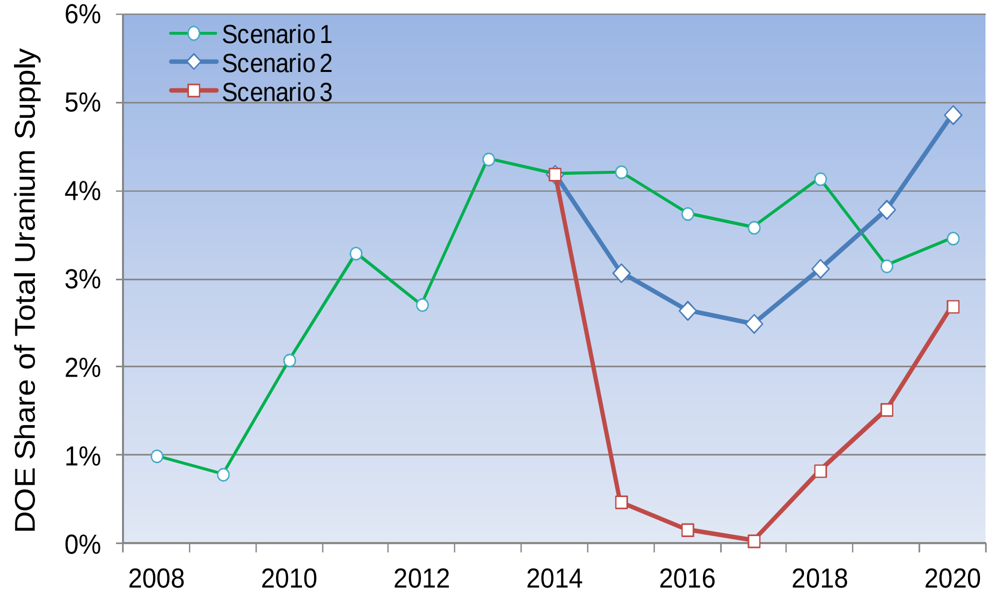

Figure 4.22 DOE Inventory Share of Total Uranium Market Supply for Three Scenarios

Figure 4.23 compares the DOE inventory relative to total secondary supply between 2008 and 2020. The DOE inventory has grown from 4% of secondary supply in 2008 to 19% in 2014. Total secondary supply declined in 2014 with the end of the HEU Agreement. The total secondary supply and DOE's share under Scenario 1 remain relatively constant through the rest of the decade.

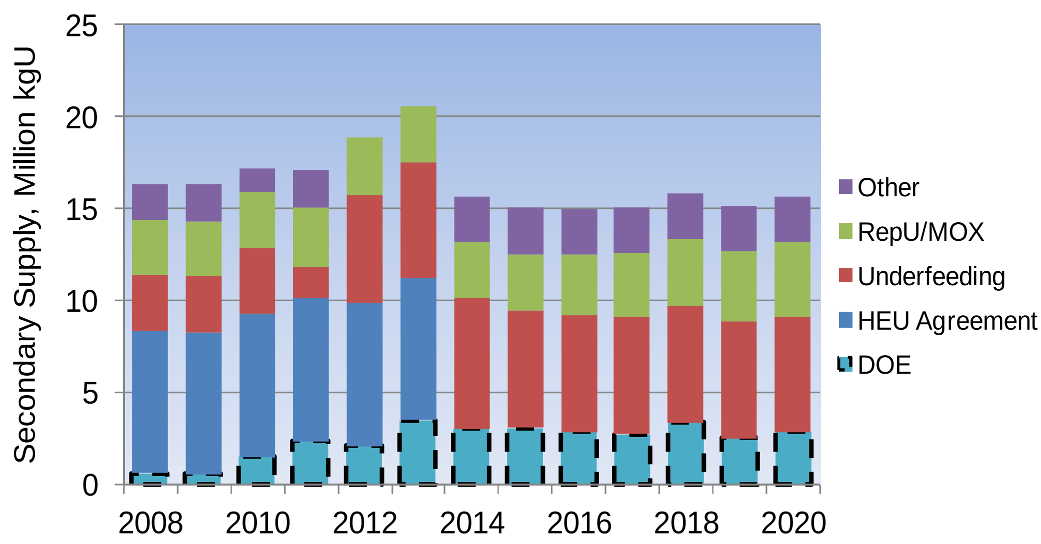

Figure 4.23 Scenario 1 DOE Inventory Relative to Total Secondary Supply

Since there is significant industry concern over the effect of DOE inventory on the spot market for uranium, DOE inventory released to the spot market (see Table 3.10) is compared against total spot market volume in Figure 4.24. Note that only DOE spot market entries from 2004 on are shown in the figure. The total spot market volume is primarily taken from Cameco company filings.[60] It is apparent that the DOE material sold on the spot market constitutes just a fraction of total spot market volume, but the fraction has been increased from 1% in 2009 to an average of 8% in 2012-2014 including an estimated 10% in 2014. The DOE material sold on the spot market for Scenario 1 and total spot market volumes are expected to remain at levels similar to 2014 for the next ten years. Less DOE inventory material would be released to the uranium spot market in the future under Scenarios 2 and 3.

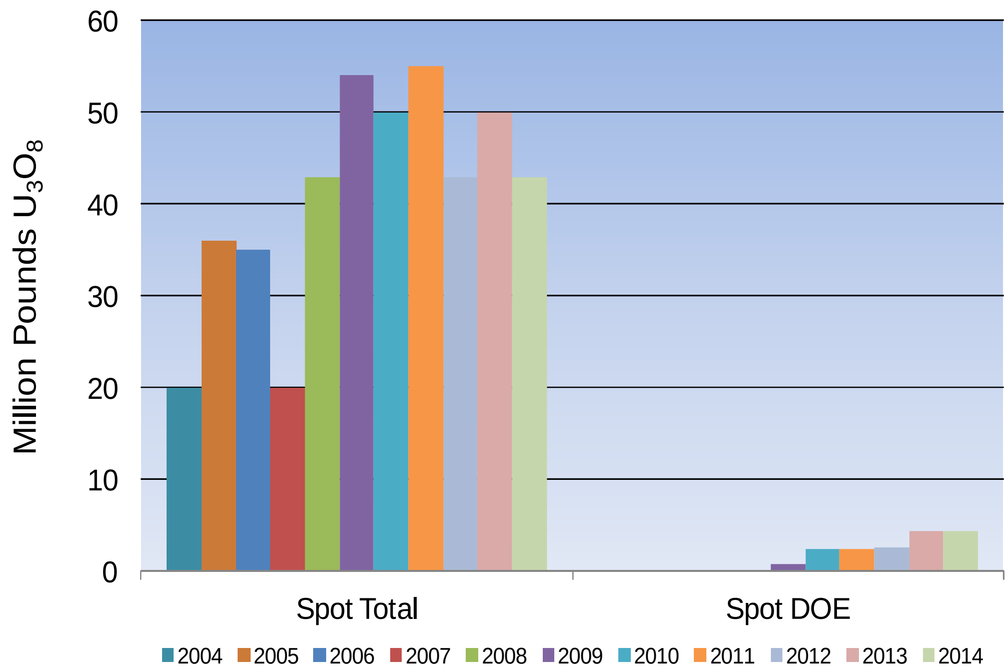

Figure 4.24 DOE Inventory Relative to Spot Uranium Market

[60] February 9, 2015 "Management's Discussion and Analysis" for the year ended December 31, 2014 and similar filings for prior years.

DOE Inventory Relative to Other Market Factors

There are many market factors which combine to determine the relationship between supply and demand, and ultimately market prices as found in published price indicators. DOE inventory releases are certainly one of the market factors, but a determination of the DOE inventory's effect can also be judged in the context of its relative contribution when compared to other market factors. A reasonable judgment on the specific contribution of DOE inventories to observed market price changes can then be made.

There have been a number of important market factors influencing the markets since DOE inventory affecting the commercial markets began to increase with the first barters in December 2009. These factors have affected both supply and demand as the markets have gone from balanced in 2008, with little or no excess supply capacity, to highly over-supplied with considerable excess supply capacity at present. Important factors in addition to the DOE inventory releases to be compared are listed below:

- Demand losses in Japan resulting from the March 2011 accident at Fukushima Daiichi
- Demand losses in Germany resulting from changes in Germany energy policy
- Increased uranium production in Kazakhstan (compared to 2008)
- Increased secondary supply (other than DOE inventory) from underfeeding by enrichers and upgrades of DUF_6 in Russia
- Ramp up in supply from the Russian Suspension Agreement (SA) as amended
- Ramp up and subsequent end of U.S.- Russian HEU Agreement in 2013

Note that these market factors do not necessarily apply to all of the markets. Figure 4.25 compares the Scenario 1 DOE inventory relative to the other uranium market factors. The uranium equivalent included in the EUP delivered to the U.S. under the Russian SA is not included as a uranium market factor as the uranium content would be delivered to other markets if not delivered to the U.S. under the SA. The DOE inventory was equivalent to about 7% of all the uranium market factors (including DOE) in 2012 and 2013, rising to 10% in 2014. The increase is mainly due to the end of supply from the U.S. - Russian HEU Agreement, which reduced the total of all the market factors by about 21%. The total of all the uranium market factors is expected to decline slightly over the remainder of the decade as Japanese requirements increase with the restart of reactors currently awaiting restart approval, partially offset by additional loss of requirements in Germany as other reactors are closed. The Scenario 1 DOE share remains around 10%. If Scenario 2 DOE inventory is assumed, the DOE share declines to 7% between 2015 and 2017, but then steadily rises to 14% by 2020. DOE inventory is not much of a uranium market factor for Scenario 3, averaging less than 1% over the next three years, rising to 8% over the following three years.

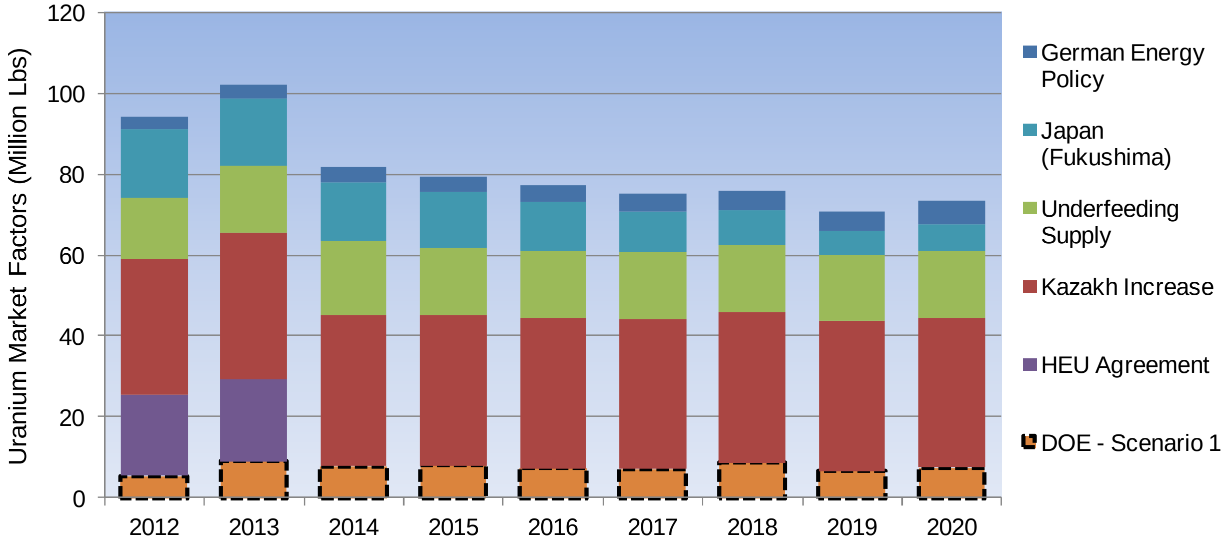

Figure 4.25 DOE Inventory Relative to Other Uranium Market Factors

Figure 4.26 compares the Scenario 1 DOE inventory relative to other conversion market factors. A major difference from Figure 4.25 is that increased uranium production in Kazakhstan does not affect the conversion market and so is not shown as a conversion market factor. Another difference is that the ramp up of supply under the Russian Suspension Agreement can affect the conversion market. It is assumed that 80% of the material supplied under the SA is in the form of EUP sales which include a conversion component. Rosatom would not have a market for these included conversion sales if the SA deliveries were not allowed, so it is included as a conversion market factor. The DOE inventory was equivalent to about 13% of all the conversion market factors (including DOE) in 2012 and 2013, rising to 16% in 2014. As with uranium, the 2014 increase is mainly due to the end of supply from the U.S. - Russian HEU Agreement. The total of all the conversion market factors is expected to decline slightly over the remainder of the decade as Japanese requirements increase with the restart of reactors currently awaiting restart approval, partially offset by additional loss of requirements in Germany as other reactors are closed. The Scenario 1 DOE share averages 17% over the next three years (2015-2017) and 19% between 2018 and 2020. If Scenario 2 DOE inventory is assumed, the DOE share declines to 13% between 2015 and 2017, but then steadily rises to 24% by 2020. DOE inventory is not much of a conversion market factor for Scenario 3, averaging 1% over the next three years, although it then rises to 10% over the following three years.

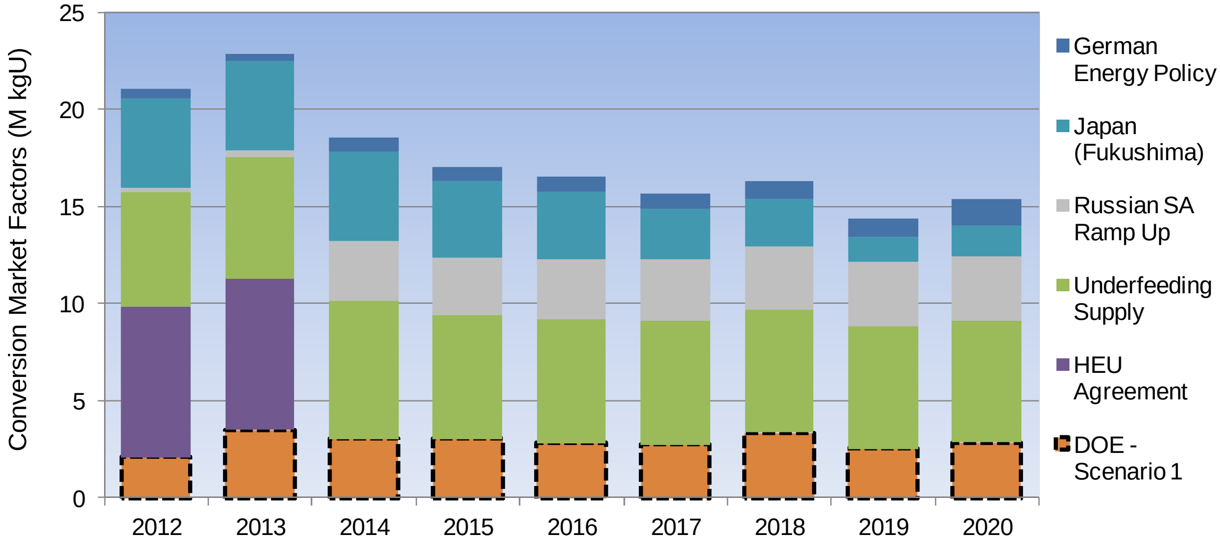

Figure 4.26 DOE Inventory Relative to Other Conversion Market Factors

Figure 4.27 compares the Scenario 1 DOE inventory relative to other enrichment market factors. Increased uranium production in Kazakhstan does not affect the enrichment market and so is not shown as a market factor. The DOE inventory was equivalent to about 7% of all the enrichment market factors (including DOE) in 2012 and 2013 but rose to 14% in 2014. The increase was due to the end of supply from the U.S. - Russian HEU Agreement, offset partially by increased supply under the Russian SA, as well as increased supply from DOE. The total of all the enrichment market factors is expected to decline over the remainder of the decade as Japanese requirements increase with the restart of reactors currently awaiting restart approval. The Scenario 1 DOE share averages 13% between 2015 and 2017, rising to 16% over the following three years. If Scenario 2 DOE inventory is assumed, the DOE share declines to 11% between 2015 and 2017, but then rises to an average of 14% over the following three years. DOE inventory is not reduced as much for the enrichment market as for the other markets under Scenario 3, averaging 5% over the next three years, rising to 8% over the following three years.

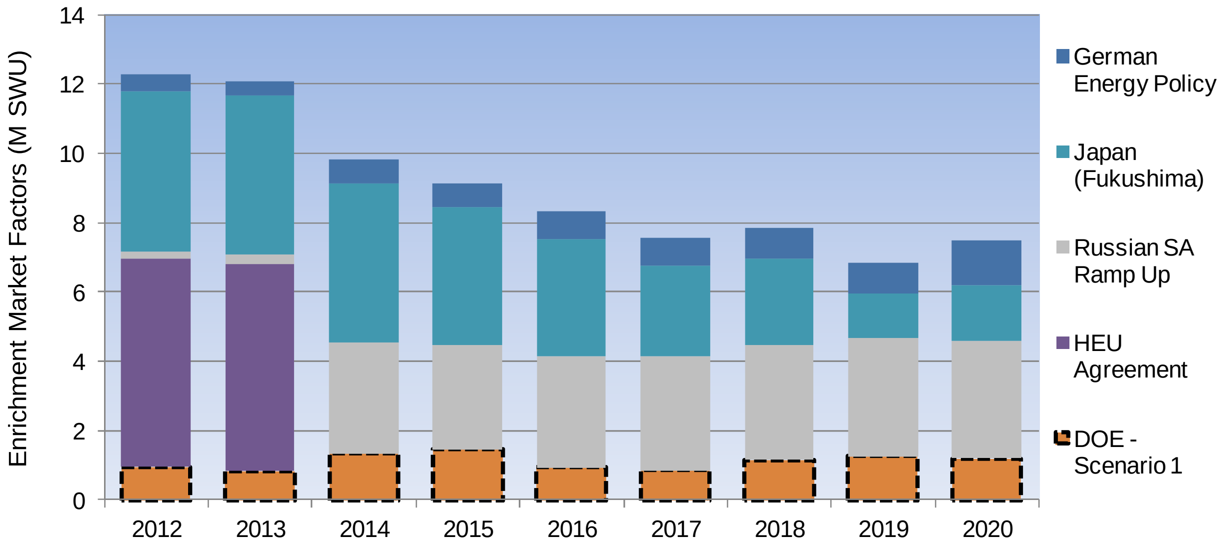

Figure 4.27 DOE Inventory Relative to Other Enrichment Market Factors

An observation which can be drawn from the discussion above is that the increased supply from the DOE inventory does not appear to be a primary driver of the current excess supply condition. In 2014, the DOE inventory was responsible for about 10% of the total of all uranium market factors, 16% of conversion market factors and 14% of enrichment market factors. The relative importance of the DOE inventory, compared to other market factors, indicates that the DOE inventory can only be considered responsible for a portion of the decline in market prices observed since the Fukushima event. This conclusion is consistent with the effects on market price developed in Section 4.1.

4.3.3 Price Effects of Individual DOE Inventory Categories

The price effects of all DOE inventory releases on each of the markets were examined in Section 4.1. The total DOE inventory releases are composed of several individual programs which have been combined into three categories as discussed in Section 3. DOE requested that ERI compare the relative importance of each of these individual programs and categories relative to the total overall effect of all DOE inventory as has been discussed throughout Section 4 of this analysis. Therefore the clearing price effect has been estimated for each of the following components of DOE inventory:

- The transfer of Blended Low-Enriched Uranium (BLEU) to TVA
- The transfer of high-assay depleted uranium tails (DUF_6) to Energy Northwest (ENW)
- Proposed transfers of DOE excess uranium currently under negotiation
- EM barters of natural UF_6 inventory and NNSA barters of LEU from HEU down blending

The price effect break downs by category are provided in Table 4.14 for the uranium market, Table 4.15 for the conversion market and Table 4.16 for the enrichment market.

Year	Uranium Price Effect ($/lb U3O8)					
	Historic		Proposed	EM and NNSA Barters		
	BLEU	ENW DUF6		Scenario 1	Scenario 2	Scenario 3
2012	$0.3			$1.7	$1.7	$1.7
2013	$0.6			$2.8	$2.8	$2.8
2014	$0.3			$2.7	$2.7	$2.7
2015	$0.3		$0.0	$2.7	$1.8	
2016	$0.1		$0.0	$2.7	$1.8	
2017	$0.0			$2.7	$1.8	
2018	$0.0	$0.6		$2.7	$1.8	
2019	$0.1	$1.0	$0.1	$1.3	$1.8	
2020	$0.1		$2.1	$0.6	$1.8	
2021	$0.1	$0.2	$2.1	$0.6	$0.9	
2022	$0.1		$2.1	$0.6	$0.4	
2023	$0.0	$0.4	$2.1	$0.6	$0.4	
2024			$2.0	$0.6	$0.4	
Total 2015-2024:						
	$0.1	$0.2	$1.0	$1.5	$1.3	$0.0

Table 4.14 Uranium Price Effect by DOE Inventory Category

Year	Conversion Price Effect ($/kgU)					
	Historic		Proposed	EM and NNSA Barters		
	BLEU	ENW DUF6		Scenario 1	Scenario 2	Scenario 3
2012	$0.1			$0.6	$0.6	$0.6
2013	$0.2			$0.9	$0.9	$0.9
2014	$0.1			$0.8	$0.8	$0.8
2015	$0.1		$0.0	$0.8	$0.6	
2016	$0.0		$0.0	$0.8	$0.6	
2017	$0.0			$0.8	$0.6	
2018	$0.0	$0.2		$0.8	$0.6	
2019	$0.0	$0.3	$0.0	$0.4	$0.6	
2020	$0.0		$0.6	$0.2	$0.6	
2021	$0.0	$0.1	$0.6	$0.2	$0.3	
2022	$0.0		$0.6	$0.2	$0.1	
2023	$0.0	$0.1	$0.6	$0.2	$0.1	
2024			$0.6	$0.2	$0.1	
Total 2015-2024:						
	$0.0	$0.1	$0.3	$0.5	$0.4	$0.0

Table 4.15 Conversion Price Effect by DOE Inventory Category

Year	Enrichment Price Effect ($/SWU)					
	Historic		Proposed	EM and NNSA Barters		
	BLEU	ENW DUF6		Scenario 1	Scenario 2	Scenario 3
2012	$2.7			$1.2	$1.2	$1.2
2013	$1.4			$2.0	$2.0	$2.0
2014	$2.7			$2.8	$2.8	$2.8
2015	$1.4	$1.8		$2.8	$1.9	
2016	$0.4	$0.6		$2.8	$1.9	
2017	$0.1	$0.6		$2.8	$1.9	
2018	$0.1	$1.8		$2.8	$1.9	
2019	$0.2	$2.0	$0.1	$2.8	$1.9	
2020	$0.4	$1.6	$0.1	$2.8	$1.9	
2021	$0.3	$2.0	$0.1	$2.8	$1.9	
2022	$0.2	$1.5	$0.1	$2.8	$1.9	
2023	$0.2	$1.3	$0.1	$2.8	$1.9	
2024				$2.8	$1.9	
Total 2015-2024:						
	$0.3	$1.3	$0.0	$2.8	$1.9	$0.0

Table 4.16 Enrichment Price Effect by DOE Inventory Category

The relative contribution on a percentage basis of each of the categories over the next ten years (2014-2024) has been summarized across the three scenarios in Table 4.17.

The relative effects of each category are identical for the uranium and conversion industries as expected since none of the DOE inventory is in the form of uranium concentrates, but rather contained as uranium equivalent in natural UF_6 or the natural UF_6 component of LEU. The BLEU inventory is seen to comprise a small portion of the total DOE price effect for uranium and conversion. The ENW DUF_6 inventory has a larger effect but also comprises a small portion of less than 10% for Scenarios 1 and 2. The proposed inventory releases currently under negotiation (primarily additional DUF_6 to GLE) are more significant, comprising 40% of the average total DOE price effect over the next ten years for Scenarios 1 and 2. The EM and NNSA barters are the largest contributor, comprising about 50% of the total DOE price effect for Scenarios 1 and 2.

	Share of DOE Price Effect (2015-2024)					
	Historic		Proposed	EM and NNSA Barters		
	BLEU	ENW DUF6		Scenario 1	Scenario 2	Scenario 3
			Uranium			
Scenario 1	3%	8%	36%	53%		
Scenario 2	3%	9%	39%		49%	
Scenario 3	6%	17%	77%			0%
			Conversion			
Scenario 1	3%	8%	36%	53%		
Scenario 2	3%	9%	39%		49%	
Scenario 3	6%	17%	77%			0%
			Enrichment			
Scenario 1	8%	29%	1%	62%		
Scenario 2	9%	37%	1%		53%	
Scenario 3	20%	77%	3%			0%

Table 4.17 Relative Price Effect Summary by DOE Inventory Category

The relative effects of each category are different for the enrichment industry. The EM and NNSA barters are still the primary contributor, comprising 50% to 60% of the price effect for Scenarios 1 and 2. The proposed inventory releases are seen to be insignificant for the enrichment industry, however, while the BLEU and ENW DUF_6 inventories become more important at 37% and 46% of the average total DOE price effect over the next ten years for Scenarios 1 and 2, respectively.

Under Scenario 3, the EM and NNSA barter relative share goes to 0% but the total price impact also declines by about 50% as a result. The proposed inventory transfers are then the dominant contributor for uranium and conversion, while the ENW DUF_6 transfers are the dominant contributor for enrichment.

4.3.4 Importance of Other Assumptions Made by ERI

Elasticity in the Uranium Markets

Price elasticity may dampen the price effects attributed to DOE transfer material. The price effects attributed to DOE material in this analysis are conservative in that they do not take credit for any DOE price effect dampening due to elasticity. In other words, the clearing price methodology assumed demand and supply are inelastic. ERI has not attempted to characterize the level of the potential dampening effect of elasticity on the price effects attributed to the DOE transfer material, but believes it would not be significant.

Mix of DOE Material Deliveries to the Term and Spot Markets

Between 53% and 62% of the uranium concentrates, conversion services and enrichment services contained in the DOE inventory material is being delivered to end-users through spot market arrangements, while the remaining 38% to 47% is being delivered under term contract arrangements for Scenarios 1 and 2 over the next ten years. Similar percentages apply to DOE inventory affecting the markets in 2014 The share of material delivered through the spot market over the next ten years declines to about 40% for uranium and conversion and to just 1% for enrichment under Scenario 3.

The calculation of market clearing price effect considers total market supply, including DOE inventory, and total market requirements. It does not differentiate as to whether the supply was contracted to end-users under spot or term arrangements. The uranium industry has consistently stated its preference for DOE inventory releases through term market sales rather than spot market sales. While contracting practices differ among companies, it is typical for about 50% of delivered uranium prices to be linked to the spot market price.[61] Contract pricing in the conversion and enrichment markets are not typically linked to spot market price indicators.

Section 4.1.2 looked at the effect of DOE inventory releases on uranium spot prices using an econometric correlation model. The correlation indicates that if a greater percentage of DOE inventory is sold through spot market arrangements then the effect on uranium spot market prices is higher. At present 50% of EM barters and 100% of NNSA barters are assumed to take place under spot arrangements. Scenario 1 DOE inventory releases were projected to lead to an average spot market price effect of \$2.4/lb U_3O_8 in 2015-2017 and \$5.1/lb U_3O_8 in 2018-2024, corresponding to 6% and 9% of expected spot market prices without the Scenario 1 sales. If 100% of the future Scenario 1 EM and NNSA barters are assumed to take place on the spot market, then the price effect increases to \$3.7/lb U_3O_8 in 2015-2017 and \$6.1/lb U_3O_8 in 2018-2024, corresponding to 9% and 10% of expected spot market prices without the Scenario 1 sales. If 0% of the future Scenario 1 EM and NNSA barters are assumed to take place on the spot market, then the price effect declines to \$0.3/lb U_3O_8 in 2015-2017 and \$2.0/lb U_3O_8 in 2018-2024, corresponding to 1% and 4% of expected spot market prices without the Scenario 1 sales.

Proportion of the DOE Material Going to the U.S. Market

The uranium, conversion and enrichment markets are global in nature and the commodities are fungible. In general pricing for uranium, conversion and enrichment is the same for the U.S. market and non-U.S. markets. The one exception is conversion, where prices for North American delivery have averaged about 4% lower than prices for European delivery[62] in recent years. The effect of DOE inventory material on global prices is the

[61] Floors and ceilings can limit the impact of large spot market price changes on the delivered price.

[62] The difference stems from a location imbalance between enrichment and conversion capacity. North America has more conversion capacity relative to enrichment capacity while Europe has less. The resulting

same whether material goes to end-users inside or outside the U.S. market. The proportion of the material going to the U.S. market has been assumed to be 100% for the historical transfers (TVA BLEU and ENW DUF_6), 50% for EM and NNSA barters and 50% for proposed releases (primarily DUF_6 to GLE). The resulting total share of DOE inventory going to the U.S. market over the next ten years is then 50% for uranium and conversion and 64% for enrichment services. The shares going to the U.S. market are the same for all three Scenarios for uranium and conversion, while the share increases to 75% for enrichment under Scenario 3. The effect of the proportion of DOE material going to the U.S. market on domestic industry sales volumes is discussed in conjunction with domestic industry market share below.

Domestic Industry Market Share

As was noted in the discussion of DOE material effect on sales volumes, it can be argued that there may be some regional differences in the effect of the DOE material, specifically in the U.S. The proportion of the DOE material sold to U.S. end-users is expected to be larger than the U.S. markets share of total world demand. Similarly, the share of sales typically contracted with U.S. end-users by the domestic industries may be larger than the U.S. markets share of total world demand. These conditions could lead to a larger effect on domestic industry sales volumes from the DOE material. The larger effect is based on the assumption that domestic industry is unable to adjust market share with non-U.S. customers in response to a lower market share with U.S. customers resulting from the DOE material sales. ERI finds this assumption to be too rigid. The markets for uranium, conversion and enrichment are global in nature and the commodities are fungible. While the C.I.S. market has been closed to U.S. industry, there are no trade restrictions on U.S. nuclear commodities (the same cannot be said for Russian exports). The Chinese market is responsible for much of the expected future growth in requirements and while enrichment and EUP sales have been made by foreign suppliers, there may not be much opportunity for new conversion and enrichment sales as China intends to meet those needs from internal supply. China does import large amounts of uranium concentrates and is expected to continue to do so for the long term. There are some reasons why domestic end-users and suppliers may prefer doing business with another, but market shares are not set in stone and respond to changes in market dynamics.

For conversion market share, if ConverDyn's world market share were higher (that is, if ConverDyn's overall sales volume was higher), it would have more production over which to spread its fixed costs. The result would be a somewhat smaller impact on production costs than calculated in Section 4.2.2. However, even if ConverDyn's world market share were higher, it would still be impacted by the reduction in price associated with the introduction of DOE material into the market.

need to incur additional shipping charges for required transport to European enrichment plants results in the price difference.

Regional Differences Affecting Supply and Demand Curves

There are regional differences in the markets for uranium, conversion services and enrichment services that may affect supply and demand. Western converters have not typically had access to the supply of UF_6 for power reactors in Russia and Russian-supplied reactors in Eastern Europe. For example, ConverDyn has noted in the past that it does not have access to the markets in either Russia or China. Western enrichers also do not have access to the market for the supply of enrichment services or EUP to power reactors in Russia or Russian-supplied reactors in Eastern Europe. Western enrichers have sold enriched uranium to China; however, China is generally expected to increase its indigenous production of UF_6 and enriched uranium to keep pace with its growing reactor requirements. So, while long-term demand from China and Russia is expected to increase, this does not necessarily result in increased demand for services from Western converters and enrichers since sales by these producers are expected to be limited.

DOE Material Effect on Sales Volumes

The introduction of DOE material results in an increase in the level of secondary supply for each of the three domestic uranium industries relative to the secondary supply available absent the DOE material. It is typically assumed that secondary supply will first be exhausted and that primary supply will then be used to fulfill remaining market demand. Thus, any increase in secondary supply, including DOE material, will result in a decrease in sales volumes sourced from primary production for these industries. Sales volumes for both domestic and non-domestic suppliers will decline relative to the scenario where no DOE material is made available to the market. The uranium, conversion and enrichment markets are global in nature. End-users purchase from suppliers worldwide in each of these industries and suppliers worldwide are generally able to sell into markets in all regions, not just to the region in which the supplier is located. Thus, as a first order estimate, the effect of DOE material on individual supplier sales volumes will be proportional to the supplier's world market share as well as the quantity of DOE material relative to world demand.

It can be argued that there may be some regional differences in the effect of the DOE material, specifically in the U.S. The proportion of the DOE material sold to U.S. end-users is expected to be larger than the U.S. markets share of total world demand. Similarly, the share of sales typically contracted with U.S. end-users by the domestic industries may be larger than the U.S. markets share of total world demand. These conditions could lead to a larger effect on domestic industry sales volumes from the DOE material. The larger effect is based on the assumption that domestic industry is unable to adjust market share with non-U.S. customers in response to a lower market share with U.S. customers resulting from the DOE material sales. ERI finds this assumption to be too rigid. The markets for uranium, conversion and enrichment are global in nature and the commodities are fungible. While the C.I.S. market has been closed to U.S. industry, there are no trade restrictions on U.S. nuclear commodities (the same cannot be said for Russian exports). The Chinese market is responsible for much of the expected future growth in requirements and while enrichment and EUP sales have been made by foreign suppliers, there may not be much opportunity for new conversion and enrichment sales as China intends to meet those needs from internal supply. China does import large amounts of uranium concentrates and is expected to continue to do so for the long term. There are some reasons why domestic end-users and suppliers may prefer doing business with another, but market shares are not set in stone and respond to changes in market dynamics.

Change in Effects from a 500 MTU Increase or Decrease in DOE Material Released

An increase or decrease of 500 MTU in DOE material that is introduced into the market will result in a subsequent, proportional increase or decrease in secondary market material. An increase of 500 MTU in DOE material that is introduced into the market results in a decrease in the prices of uranium and conversion. In contrast, a decrease of 500 MTU in DOE material that is introduced into the market should result in an increase in the price of uranium and conversion (relative to a case without the subject decrease of 500 MTU). The 500 MTU is equivalent to about 3% of U.S. uranium and conversion requirements and 0.7% to 0.8% of world uranium and conversion requirements over the next ten years (2015-2024). The clearing price effect of DOE inventory is projected to decrease by $0.5/lb for uranium and $0.16/kgU for conversion services for a 500 MTU decrease in DOE material released. The price effect is equivalent to 1.3% of the current uranium spot price, 1.8% of the current conversion spot price and 1.0% of both the current uranium and conversion term prices.

5. Summary of Market Effect

This section summarizes the market effects associated with the entry of DOE inventories into the domestic uranium, conversion and enrichment markets. This includes an evaluation of the price effect associated with the entry of DOE material in the commercial markets and the subsequent displacement of commercial supply. Other metrics were also evaluated for the domestic industries including: employment, production, volumes of inventory relative to market volumes, market capitalization, realized prices and production costs for the uranium production industry; and U.S. converter sales volumes, production costs and workforce reductions; and effect on volumes of enrichment services. The DOE inventories were compared to other market factors to help gauge the relative impact of the DOE material on the markets. The price effects of the different DOE inventory categories of material were also detailed. Additional nuclear fuel market considerations examined included price volatility, price elasticity and other assumptions regarding the markets.

The April 2014 ERI market analysis included a summary of industry views regarding the effects of the introduction of DOE inventory entering the market. While there were additional statements from the U.S. industry following the 2014 Determination, the views of industry that were summarized in April 2014 ERI market analysis have not changed substantially and are not repeated in the supplemental analysis.

5.1 DOE Inventory Affecting the Market, 2015 to 2024

The quantities of equivalent DOE natural uranium and enrichment services expected to affect the commercial markets during the time period addressed by this analysis (2015 - 2024) were split into three categories. The categories of material include (i) historical DOE transfers still affecting the commercial markets, (ii) ongoing inventory transfers in exchange for services (barters), and (iii) proposed transfers of additional DUF_6, off-spec LEU, and off-spec non-UF_6 that are currently under negotiation with selected companies as a result of earlier DOE RFOs. Three release rate scenarios were provided to ERI by DOE.

During the period 2015 to 2024, the total DOE inventory affecting the market equals more than 30,000 MTU as UF_6 under Scenario 1 (22,300 MTU under Scenario 2 and 9,000 MTU under Scenario 3), which is equivalent to 78 million pounds of U_3O_8 (58 million pounds under Scenario 2 and 23.5 million pounds under Scenario 3). A total of 8.5 million SWU will enter the market during the period 2015 to 2024 under Scenario 1 (8.2 million SWU under Scenario 2 and 4 million SWU under Scenario 3). The DOE inventory releases expected to displace global commercial supply in the markets over the next ten years (2015 through 2024) under Scenario 1 average nearly 2,990 MTU as UF_6, equivalent to 7.8 million pounds U_3O_8 per year. This is equivalent to approximately 17% of annual U.S. uranium and conversion requirements and 6% of U.S. enrichment requirements. Under Scenario 2 the DOE inventory releases are equivalent to 16% of U.S. uranium and conversion requirements and 6% of U.S. enrichment requirements. Under Scenario 3, the DOE inventory releases are equivalent to 8% of U.S. uranium and conversion requirements and 3% of uranium enrichment requirements.

5.2 Current Market Conditions

It remains clear that all of the markets - uranium concentrates, conversion services and enrichment services - are in states of considerable oversupply, with mainly discretionary near-term demand for nuclear fuel and a decline of long-term contracting. The current oversupply in these markets is due to a number of factors such as demand losses in Japan resulting from the March 2011 accident at Fukushima Daiichi; demand losses resulting from changes in Germany energy policy; increased uranium production in Kazakhstan; increased secondary supply from underfeeding by enrichers and upgrades of DUF_6 in Russia; DOE inventory transfers; and the ramp up in supply from the Russian Suspension Agreement offset by the end of U.S. - Russian HEU Agreement in 2013.

The long-term prospects for nuclear power and nuclear fuel supply are generally viewed as positive, with a steady average annual nuclear capacity growth rate of approximately 2% through 2035. Related growth in nuclear fuel requirements will be even higher at about 2.5% per year as current requirements have been lowered by the ongoing reactor outages in Japan. Growth in the U.S. remains relatively flat through 2035, with the strongest growth expected to take place in China, India, Korea, and Russia. However, in the near term, the amount of time it will take to recover from the Fukushima-driven state of the current markets remains unclear. It is clear that excess supply will need to be reduced before any significant recovery in market price can take place. In the meantime, the domestic industries have felt the effects of the oversupplied markets and have taken actions, such as production and staffing cutbacks, in order to try to weather the downturn. The effects are most acute in the uranium and conversion industries.

5.3 Nuclear Fuel Market Effects

Market conditions have deteriorated considerably between the market analyses conducted in April 2012 and April 2014, but have not changed much since the April 2014 ERI market analysis. While the 2012 market analysis did foresee oversupply due to Fukushima and other factors, the timing for restart of Japanese reactors and the recovery of worldwide nuclear power development was slower than anticipated and the subsequent reduction in nuclear fuel demand was worse than anticipated in 2012. Primary uranium supply was slow to respond, continuing to increase in 2012 and 2013, but a 5% decline is estimated for 2014. As a result of the ongoing over supply, market prices have fallen considerably since April 2012. While the absolute effects on price found in the current analysis are similar to the absolute effects found in 2012, they are now more significant when evaluated against current market prices on a relative (percentage) basis.

The overall status and changes in the nuclear fuel markets have been characterized in this market analysis; however, it is more difficult to attribute the relative "responsibility" of each of the many factors which influence the market price indicators. While the DOE inventory releases clearly play a role, they must be judged in context of all market factors including reduced demand following the accident at Fukushima Daiichi as analyzed in Section 4 and summarized below.

5.3.1 Price Effect

The results of ERI's market clearing price analysis indicate that the uranium market price effect attributed to DOE inventory averages \$2.8 per pound over the period 2015-2024. This is equivalent to 8% of the current spot price and 6% of the current term price. The conversion market price effect attributed to DOE inventory averages \$0.9 per kgU as UF_6 over the next ten years. This is equivalent to 11% of the current spot price and 6% of the current term price. The enrichment market price effect attributed to DOE inventory averages \$4.5 per SWU over the next ten years. This is equivalent to 5% of the current spot price and term price. The price effects attributed to DOE inventory are already built into current market prices. If no DOE inventory releases took place, then current market prices would be higher by the amounts stated, e.g. by about \$3 per pound for uranium or by \$0.9 per kgU for conversion services.

ERI has also developed a multivariable correlation between the monthly spot market prices for uranium concentrates published by TradeTech and the active spot market supply and active spot market demand, which are also published monthly by TradeTech. This correlation was then used to simulate the 2009 through 2024 spot market price for uranium concentrates with and without the DOE inventory released to the spot market. Applying the correlation results in an estimated spot market price effect of \$2.2 per pound U_3O_8 over the last three years (2012-2014). Looking forward and assuming Scenario 1 DOE inventory release rates, the correlation results in projected spot market price effects of \$2.4 per pound U_3O_8 over the next three years (2015-2017) rising to an average effect of \$5.1 between 2018 and 2024 as spot market prices recover. This represents an estimated effect of 6% lower spot market prices over the next three years and 9% lower over the following seven years if Scenario 1 DOE inventory releases take place over the next ten years (2015-2024) compared to no release of DOE inventory. The price effect is on future spot market prices, which are projected to eventually rise with or without the DOE inventory releases. The price effects attributed to past and current DOE inventory releases are already built into current spot market prices. If the past releases had not occurred, then current spot market prices would be higher by approximately \$2 per pound U_3O_8.

Despite some gains during the second half of 2014, market prices have declined considerably since the Fukushima event three and a half years ago. Uranium, conversion and enrichment spot price indicators have all demonstrated similar declines, with prices as of January 31, 2015 for uranium, conversion and enrichment lower by 46%, 35% and 43%, respectively, than prices on February 28, 2011 just prior to the Fukushima event. For the term markets, enrichment prices are down 43% mirroring the spot price behavior. Uranium term prices are down 29%, a little less drastic reduction than observed for the uranium spot price. Conversion term prices are the exception and are actually 3% higher.

5.3.2 Other Market Factors

In addition to quantifying the effect of DOE inventory on the price of uranium, conversion and enrichment, this market analysis addresses additional metrics such as employment, production, volumes of inventory relative to market volumes, market capitalization, realized prices and productions costs in the uranium market. Effects, in addition to market price changes associated with DOE inventory, include changes in U.S. converter sales volume and production costs, and the reduction in workforce associated with reduced sales volumes. The DOE inventories were compared to other market factors to help gauge the relative impact of the DOE material on the markets. The price effects of the different DOE inventory categories of material were also detailed. Additional nuclear fuel market considerations examined included price volatility, price elasticity and other assumptions regarding the markets.

Summary of Uranium Market Effects

- **Employment**: A price-employment correlation has been used to estimate the effect of the DOE inventory releases on U.S. uranium industry employment. The estimate of the effect of DOE material on average market price in 2013-2014 is $3.2/lb, resulting in an estimated employment loss of 44 person-years as a result of the DOE inventory released to the market. This corresponds to a reduction in uranium industry employment of 4.1% in 2014. Looking forward, the uranium market price effect of DOE uranium inventory is expected to average $2.8/lb over the next ten years (2015-2024) under Scenario 1. This results in an estimated long-term employment loss of 42 person years, meaning that future employment is reduced by approximately 3.8% on average as a result of the DOE inventory releases. Corresponding estimates for employment loss over the next ten years are 39 and 21 person-years for Scenarios 2 and 3, respectively, equivalent to 3.6% and 2.0% reductions relative to future employment if no DOE inventory releases take place.

- **Production**: While U.S. uranium industry production has risen since 2003 and continued to rise after the start of the DOE uranium inventory barters in December 2009 as well as during the market decline in 2013 and 2014, there has been an effect on the actual and planned production of some U.S. operations. Announcements of cutbacks in existing U.S. uranium production first started appearing in 2012 and have continued into 2014. The reduction in production from these cutbacks is expected to be about 0.8 million pounds in 2014. Total U.S. production in 2014 is increased by 5% as production from new ISL operations ramping up offset the cutbacks at the other sites. The number of uranium production centers in operation in the U.S. has increased through 2014, with one more new center planned for 2015. However, a number of U.S. production centers are no longer installing new well fields, and production at these sites is declining as a result. The new production centers are back stopped by older term-contracts with higher prices, but current prices are not supportive of new development. U.S. production in 2015 is expected to decline back to 2012 levels or slightly lower, even though the Peninsula's Lance ISL project may start up in the second half of the year.

- **DOE Inventory Relative to Total Market Supply:** The DOE inventory's share of total uranium market supply has grown from about 1% in 2008 and 2009 to 4.3% for 2013 and 2014. A slight decline to 3.7% over the next three years (2015-2017) is projected for Scenario 1. A larger decline is projected for the next three years under Scenarios 2 and 3, where DOE inventories are projected to average 2.7% and 0.2% of total uranium market supply, respectively. The supply shares for Scenarios 2 and 3 will then start to rise, however, and Scenario 2 will average 4.4% in 2019 and 2020, which is higher than the 3.4% of Scenario 1. Comparison of DOE inventories relative to total secondary supply for uranium shows that DOE inventory has grown from 4% of secondary supply in 2008 to 19% in 2014. Total secondary supply declined in 2014 with the end of the HEU Agreement. The total secondary supply and DOE's share under Scenario 1 remain relatively constant through the rest of the decade. It is apparent that the DOE material sold on the spot market constitutes just a fraction of total spot market volume, but the fraction has been increased from 1% in 2009 to an average of 8% in 2012-2014 including an estimated 10% in 2014. The DOE material sold on the spot market for Scenario 1 and total spot market volumes are expected to remain at levels similar to 2014 for the next ten years. Less DOE inventory material would be released to the uranium spot market in the future under Scenarios 2 and 3.

- **Market capitalization**: Market capitalization is an important metric for the smaller, publicly traded mining companies in the U.S. because it is representative of the ability of these companies to raise funds needed to move projects through the licensing process, which can take many years, as well as initial project development in some cases. A review of market capitalization for U.S. uranium producers shows that capitalization is sensitive to changes in the spot market price, particularly for smaller mining companies. For example, during 2010, spot price increased from $40 per pound up to $70 per pound, an increase of 75%. The market capitalization of the smaller U.S. miners increased 150% to 600% in response. Following the Fukushima accident in March 2011, market capitalization declined rapidly. While the effect of large changes in the spot market price is obvious, the effect on market capitalization from the smaller price changes attributed to DOE inventory is not as clear. Market capitalizations have declined following the April 2014 ERI market analysis as the spot market price dropped below $30/lb for the May 2014 through July 2014 period and commodity stocks declined in general. While the uranium spot price subsequently increased starting in August and was $39/lb at the end of November 2014, the market capitalizations have been slow to respond.

- **Realized Prices**: The EIA publishes average delivered price in the U.S., which have increased steadily over the past ten years, before leveling off in 2012 and declining 5% in 2013 to $52/lb-$U_3O_8$. A similar decline is expected by ERI for 2014. The EIA average delivered price in the U.S. is representative of realized prices for the uranium industry on a global basis. Realized prices for the U.S.

uranium supply industry varies from one company to another. ERI reviewed realized prices as reported in uranium producers' public filings, representing 95% of U.S. production in 2014. Comparing realized prices to the spot market price during the period 2011 to first three quarters 2014 shows that some mining companies' realized prices are spot-market based while others have hedged their exposure to the spot market by locking in prices using a base price escalated approach for a portion of their portfolio. Less than 30% of the production came from companies that were effectively unhedged (no long-term contracts with higher fixed prices).

- **Production Costs**: The EIA reports total industry expenditures for U.S. uranium production, including facility expense, in its annual Domestic Uranium Production Report. The total for 2013 was $168 million, or an average of $36 per pound when spread across 2013 uranium production of 4.66 million pounds. Three-year average production costs rose steadily between 2004 and 2009, but have been fairly level since 2009 at about $40/lb. The U.S. production cost is consistent with the $40/lb global average production cost mentioned by other market analysts. The pattern of mine cutbacks over the past few years as well as domestic industry production costs do not seem to indicate that adding back the $3 per pound price effect attributed to all DOE inventory material for Scenario 1 would move current prices enough to cause U.S. producers to ramp well field development and production activities back up. The resulting spot price level would remain near $40 per pound, still very close to average production costs, and may still not be sufficient for higher cost ISL producers to restart well field development or higher cost conventional mines to resume mining activities, and likely would not have prevented the decisions to cut back when prices declined to $35/lb in mid 2013 and then below $30/lb in mid 2014.

- **DOE Inventory Relative to Other Market Factors**: There have been a number of important market factors influencing the markets since DOE inventory affecting the commercial markets began to increase with the first barters in December 2009. These factors have affected both supply and demand as the markets have gone from balanced in 2008, with little or no excess supply capacity, to highly over-supplied with considerable excess supply capacity at present. Important factors in addition to the DOE inventory releases include demand losses in Japan resulting from the March 2011 accident at Fukushima Daiichi; demand losses resulting from changes in Germany energy policy; increased uranium production in Kazakhstan (compared to 2008); increased secondary supply (other than DOE inventory) from underfeeding by enrichers and upgrades of DUF_6 in Russia; ramp up in supply from the Russian Suspension Agreement; ramp up and subsequent end of U.S. - Russian HEU Agreement in 2013. The DOE inventory was equivalent to about 7% of all the uranium market factors (including DOE) in 2012 and 2013, rising to 10% in 2014. The increase is mainly due to the end of supply from the U.S. - Russian HEU Agreement. The total of all the uranium market factors is expected to decline slightly over the remainder of the decade as Japanese requirements increase with the restart of reactors currently awaiting restart approval, partially offset by additional loss of requirements in Germany as other reactors are closed. The Scenario 1 DOE share remains around 10%. If Scenario 2 DOE inventory is assumed, the DOE share declines to 7% between 2015 and 2017, but then steadily rises to 14% by 2020. DOE inventory is not much of a uranium market factor for Scenario 3, averaging less than 1% over the next three years, rising to 5% over the following three years.

- **Price Effects**: The uranium market price effect attributed to DOE inventory averages \$2.8 per pound over the next ten years under Scenario 1. This is equivalent to 8% of the current spot price and 6% of the current term price. The price effect attributed to DOE inventory is already built into current market prices. If no DOE inventory releases took place, then current market prices would be higher by \$2.8 per pound for uranium.

Summary of Conversion Market Effects

- **Impact on Conversion Services Sales Volume**: Sales volume effects to ConverDyn due to the introduction of DOE inventory result in a sales volume reduction of 8% under Scenario 1, 6% under Scenario 2 and 1% under Scenario 3.

- **Comparison of DOE Inventory with Other Market Factors**: The DOE inventory was equivalent to about 13% of all the conversion market factors (including DOE) in 2012 and 2013, rising to 16% in 2014. As with uranium, the 2014 increase is mainly due to the end of supply from the U.S. - Russian HEU Agreement. The total of all the conversion market factors is expected to decline slightly over the remainder of the decade as Japanese requirements increase with the restart of reactors currently awaiting restart approval, partially offset by additional loss of requirements in Germany as other reactors are closed. The Scenario 1 DOE share averages 17% over the next three years (2015-2017) and 10% between 2018 and 2020. If Scenario 2 DOE inventory is assumed, the DOE share declines to 13% between 2015 and 2017, but then steadily rises to 25% by 2020. DOE inventory is not much of a conversion market factor for Scenario 3, averaging 1% over the next three years, rising to 10% over the following three years.

- **Impact on Conversion Services Production Cost**: The loss of sales volume is estimated to increase ConverDyn's production costs by 1% under Scenario 3, up to 6% under Scenario 2, and up to 7% under Scenario 1.

- **Workforce Reduction Associated with Volume Reduction**: When Metropolis Works restarted in 2013, the workforce was 80% of the pre-shutdown workforce in early 2012. The decrease in work force was due to lower market demand.

- **DOE Inventory Share of U.S. and World Conversion Services Demand**: The release of approximately 3 million kgU as UF_6 of DOE inventory into the market annually in 2015 and 2016 represents 5% of worldwide conversion services demand and 19% of U.S. conversion demand under Scenario 1. Under Scenario 2, the release of approximately 2.2 million kgU as UF_6 of DOE inventory into the market annually in 2015 and 2016 represents 4% of worldwide demand and 14% of U.S.

demand. Under Scenario 3, the release of 0.3 million kgU as UF_6 of DOE inventory annually in 2015 and 2016 represents less than 1% of worldwide demand and 2% of U.S. demand.

- **Price Effects**: The conversion market price effect attributed to DOE inventory under Scenario 1 averages \$0.9 per kgU as UF_6 over the next ten years. This is equivalent to 10% of the current spot price and 5% of the current term price. Under Scenario 2, the price effect averages \$0.8/kgU over the next ten years and under Scenario 3, the price effect averages \$0.4/kgU over the next ten years. The price effects attributed to DOE inventory are already built into current market prices. If no DOE inventory releases took place, then current market prices would be higher by \$0.9 per kgU for conversion services under Scenario 1.

Summary of Enrichment Market Effects

- The current over-supply in the enrichment market is due primarily to Fukushima-related demand loss and the subsequent increase in inventories of EUP, with enrichment capacity well in excess of enrichment requirements. Since it is not practical to reduce production from existing centrifuge enrichment capacity, excess capacity is redirected to uranium production in the form of UF_6 by underfeeding and re-enriching tails.

- The release of 1.1 million SWU per year associated with the entry of DOE inventory into the market during the period 2015 to 2024 under Scenario 1 represents 2% of worldwide enrichment services demand and 7% of U.S. enrichment services demand over this period. The shares of world and U.S. requirements are essentially unchanged for Scenario 2, but decline to 1% and 3%, respectively, for Scenario 3.

- Enrichment market prices have declined by 43% in both the spot and term markets since the Fukushima event three and a half years ago.

- The enrichment market price effect attributed to DOE inventory averages \$4.5 per SWU over the next ten years. This is equivalent to 5% of the current spot and term prices.

5.3.3 Additional Notes

As stated by ERI in previous market analyses, even if the potential effect of any individual transfer by DOE is not in itself significant, the nuclear fuel markets recognize that DOE controls a very large amount of material. The predictability of DOE's transfer of that material into the commercial markets over time is very important to the orderly functioning of these markets. In this regard, it is critical for long-term planning and investment decisions by the domestic industry that there can be confidence that DOE will adhere to what it presents as being established guidelines and plans. In the 2013 DOE Plan, DOE stated that it "determined that it can meet its statutory and policy objectives in regard to

DOE uranium sales or transfers without an established guideline." The 2013 Plan stated that the previously established guideline limiting DOE transfers to 10% of U.S. annual requirements, which was established in DOE's 2008 Plan, would no longer be used. Based on feedback received by ERI from representatives of the U.S. uranium and conversion industries, the decision by DOE to no longer have an established guideline that would limit DOE inventory transfers to 10% was interpreted by the U.S. industry and investment community as an indication that DOE is not acting in a predictable manner regarding its inventory releases.

It is clear that there have been production, employment and financial effects on the domestic industry due to a variety of market factors culminating in the current oversupplied markets. Based on the analysis contained in this study, it is not clear that the elimination of DOE inventory releases would cause the overall market conditions to change enough to make a significant difference in the health and status of the domestic industries. Feedback was received from representatives of the U.S. uranium and conversion industries while preparing the April 2014 ERI market analysis. The domestic industries clearly felt that a reduction in the amount of DOE inventory released to the markets would make a difference, in part by sending a strong signal to the markets that DOE recognizes the current weak state of the nuclear fuel markets, in which there is considerable oversupply, near-term demand is mostly discretionary, long-term contracting remains below normal delivery replacement levels[63], and that DOE is responding to these market conditions.

[63] On average, new contracting by end-users should be at levels which replace deliveries made under older contracts during the year, thereby maintaining the same level of forward commitments.

GLOSSARY

centrifuge – A device that can spin at extremely high speeds and separate materials of different densities. For uranium, centrifuges are able to separate the uranium-235 isotopes from the uranium-238 isotopes based on their difference in atomic weight.

conversion – In the context of nuclear fuel, the process whereby natural uranium in the form of an oxide is converted to uranium hexafluoride.

depleted uranium (DU or DUF_6) – Uranium whose content of the fissile isotope uranium-235 is less than the 0.711 percent (by weight) found in natural uranium, so that it contains more uranium-238 than found in natural uranium.

down blending – The term used to describe the process whereby highly enriched uranium is mixed with depleted, natural, or low enriched uranium to create low enriched uranium.

enriched uranium – Uranium whose content of the fissile isotope uranium-235 is greater than the 0.711 percent (by weight) found in natural uranium. (See uranium, natural uranium, and highly enriched uranium.)

enrichment – In the context of nuclear fuel, the separation of the uranium-235 isotope from the more common uranium-238 isotope to create enriched uranium.

equivalent – In the context of uranium concentrates equivalent, conversion services equivalent, enrichment services equivalent, this refers to the equivalent amount of each of these materials and services that is included in the LEU that is derived from the blended down HEU. While the LEU is not physically subdivided into these components, from a commercial perspective the components can be transferred individually.

fissile material – Any material fissionable by thermal (slow) neutrons. The three primary fissile materials are uranium-233, uranium-235, and plutonium-239.

gaseous diffusion – A uranium enrichment process where uranium hexafluoride in gaseous form is forced through a series of semi-porous membranes to increase the concentration of uranium-235 isotopes.

highly enriched uranium or HEU – Uranium whose content of the isotope uranium-235 has been increased through enrichment to 20 percent or more (by weight). (See natural uranium, enriched uranium, and depleted uranium.)

in situ leaching (ISL) or in situ recovery (ISR) –The extraction of uranium by injecting a solution underground which then leaches the uranium from a permeable ore-body. The uranium containing (pregnant) solution is pumped back to the surface and processed to produce uranium concentrates. The process involves little surface disturbance and no tailings or waste rock generation.

kgU – Kilograms of uranium.

long-term or term price – In the context of this report, refers to the price paid for nuclear fuel materials and services that will be delivered more than one year after the contract is signed.

low-enriched uranium or LEU – Uranium whose content of the fissile isotope uranium-235 has been increased through enrichment to more than 0.7 percent but less than 20 percent by weight. Most nuclear power reactor fuel contains low-enriched uranium containing 3 to 5 percent uranium-235.

MT and MTU – Metric tons and metric tons of uranium.

natural uranium or NU– The material provided to a uranium enricher for producing enriched uranium and uranium tails.

reactor core – The fuel assemblies, fuel and target rods, control rods, blanket assemblies, and coolant/moderator of a nuclear power plant. Energy is produced in this part of the nuclear power plant.

separative work units or SWU – The unit of measurement for the effort needed to enrich uranium.

spot market price or spot price – In the context of this report, refers to the price paid for nuclear fuel materials and services that will be delivered soon (e.g., usually within 12 months) after the contract is signed.

tails – Refers to depleted uranium produced during the uranium enrichment process.

term or term market price – See **long-term price**.

uranium concentrates or U_3O_8 – The form of uranium that is the end product of the uranium milling process, which follows mining of the uranium ore. This compound can be converted through a uranium conversion process into uranium hexafluoride.

uranium hexafluoride or UF_6 – The form of uranium that is the end product of the uranium conversion process. This compound can be easily transformed into a gaseous state at relatively low temperatures to allow the uranium to feed through a uranium enrichment process, either gaseous diffusion or gas centrifuge.