



December 2015

# U.S. COINS

## Implications of Changing Metal Compositions

Accessible Version

# GAO Highlights

Highlights of [GAO-16-177](#), a report to congressional requesters

## Why GAO Did This Study

The U.S. Mint, a bureau of the Treasury, produced about 13 billion coins in 2014. Since 2006, metal prices have risen to where the unit costs of a penny and nickel exceed their face value. The U.S. Mint was directed by statute to develop and evaluate the use of new metals that would reduce the costs of coin production while minimizing the impact on coin accepting equipment. Treasury is authorized to recommend coin changes to Congress based on the U.S. Mint's analysis and has not yet done so. GAO was asked to examine the U.S. Mint's efforts.

This report examines (1) what is known about potential government savings from changes to the metal composition of coins; (2) what is known about potential industry costs from changes to the metal composition of coins; and (3) how potential coin composition options could affect government savings and industry costs. GAO reviewed legislative provisions and U.S. Mint estimates of government savings; compared the U.S. Mint's estimating process to best practices; and reviewed cost estimates from associations that represent selected businesses that submitted estimates to the U.S. Mint, such as the vending and laundry industries. GAO interviewed U.S. Mint officials and industry representatives to understand how their estimates were developed.

GAO is not making recommendations in this report. In comments, the U.S. Mint questioned GAO's use of the *Cost Guide* to assess the U.S. Mint's estimates. GAO continues to believe it is appropriate to use the *Cost Guide* to assess the U.S. Mint's estimates.

View [GAO-16-177](#). For more information, contact Lori Rectanus at (202) 512-2834 or [RectanusL@gao.gov](mailto:RectanusL@gao.gov).

December 2015

## U.S. COINS

### Implications of Changing Metal Compositions

## What GAO Found

The U.S. Mint estimated that the government could potentially save between \$8 million and \$39 million per year by changing the metal composition of the nickel, dime, and quarter. The estimated savings of \$8 million would come from slightly changing the current metal in coins, which would decrease metal costs and retain the characteristics of existing coins. The savings of \$39 million would come from changing the nickel and dime to a plated steel coin, which would change the coin's weight and other characteristics. While the U.S. Mint previously estimated potential savings of \$83 million per year by changing the nickel, dime, and quarter to a plated steel-based coin, the U.S. Mint determined that it was not viable to change the quarter because less-valuable foreign coins would have similar characteristics to a steel quarter and could be used as counterfeit quarters. GAO found that the U.S. Mint's cost-estimating process does not fully align with best practices outlined in the *GAO Cost Estimating and Assessment Guide (Cost Guide)* and as such may not result in precise estimates. For example, U.S. Mint officials discussed but did not conduct a sensitivity analysis—a best practice—that would have allowed them to know how savings estimates could be affected by changes in metal prices. However, the U.S. Mint's estimates can provide insight into the general magnitude of potential savings.

Associations representing selected industries that use coin acceptance machines estimated a cost impact ranging from \$2.4 billion to \$10 billion to modify an estimated 22-million coin machines, such as vending machines, to accommodate steel-based coins. According to these associations, these costs would be incurred because coin machines would require modifications to accept new coins while continuing to accept current coins. However, GAO found that these estimates may be overstated for several reasons. For example, the vending industry assumed 7-million vending machines would require modification, but a 2015 industry study estimated that there are 4.5-million vending machines in the United States. Second, the cost estimates assumed steel changes to all coins, but the U.S. Mint has determined it is not viable to change the quarter. Therefore, machines that only accept quarters (such as coin laundry machines) would not require modification. However, any change in coin composition that requires changes to coin acceptance machines will result in some industry costs.

Although government savings and industry cost estimates may not be precise indicators of savings and costs, they nonetheless show that metal compositions that would increase government savings also increase industry costs. U.S. Mint estimates show that one change could result in no industry costs but show a savings of only \$8 million annually. In contrast, changing the nickel and dime to multi-ply plated steel coins could save \$39 million annually but result in substantial industry costs. The Coin Modernization, Oversight, and Continuity Act of 2010 requires that any new coins work in existing machines that accept coins "to the greatest extent practicable." U.S. Mint officials have not yet analyzed whether the options they are considering meet these criteria for making recommendations to Congress. U.S. Mint officials said when and if the Department of the Treasury (Treasury) makes recommendations to Congress, they will ensure that recommendations are within the framework of the Act.

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**Abbreviations**

The Act	Coin Modernization, Oversight, and Continuity Act of 2010
<i>Cost Guide</i>	<i>GAO Cost Estimating and Assessment Guide</i>
CTC	Concurrent Technologies Corporation
Cupronickel	Copper and nickel
EMS	electromagnetic signature
Navigant	Navigant Consulting
OMB	Office of Management and Budget
<i>SFFAS 4</i>	<i>Statement of Federal Financial Accounting Standard 4</i>

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December 10, 2015

The Honorable Bill Huizenga  
Chairman  
Subcommittee on Monetary Policy and Trade  
Committee on Financial Services  
House of Representatives

The Honorable Steve Stivers  
House of Representatives

According to one estimate, there were over 355 billion U.S. coins circulating in the United States in 2012. The U.S. Mint, a bureau of the Department of the Treasury, is responsible for making coins and produced about 13-billion circulating coins in 2014.<sup>1</sup> Coins play a major role in commerce, as consumers use them daily to purchase food and beverages from vending machines, wash clothes at coin-operated laundries, and procure entertainment at amusement venues, among other things. Since 2006, the prices of metals used in coins have risen so much that the total production unit costs of the penny and nickel exceed their face value resulting in financial losses to the U.S. Mint. The Coin Modernization, Oversight, and Continuity Act of 2010 (the Act) directed the Department of the Treasury to develop and evaluate the use of new metallic materials in coins and make recommendations that would reduce the costs of coin production.<sup>2</sup> The Act also directed the Department of the Treasury to consider the impact of any metal change on equipment that accepts coins in developing these recommendations. As of November 2015, the Department of the Treasury has not made any recommendations.

You asked us to review the U.S. Mint's research and development efforts to determine options to change the metal composition of circulating coins as well as industry cost estimates for changing equipment to accept new coins. This report examines (1) what is known about potential government savings from changes to the metal composition of coins; (2) what is

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<sup>1</sup>Circulating coins are the 1-cent, 5-cent, 10-cent, 25-cent, 50-cent and 1-dollar coins that the general public can use to make purchases.

<sup>2</sup>Pub. L. No. 111-302, 124 Stat. 3272 (2010).

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known about potential industry costs from changes to the metal composition of coins; and (3) how potential coin composition options could affect government savings and industry costs.

To address these objectives, we reviewed the Act as well as the two previous U.S. Mint biennial reports to Congress on this matter, which were required by the Act. We reviewed estimates of government savings developed by the U.S. Mint and assessed how the U.S. Mint's estimating process compared with best practices from the *GAO Cost Estimating and Assessment Guide (Cost Guide)*.<sup>3</sup> We also reviewed a 2012 estimate of government savings that was produced by a consulting firm—Navigant Consulting (Navigant)—and commissioned by a supplier of coin material. We reviewed estimates of potential industry costs from changes to the metal composition of coins. These estimates were provided to the U.S. Mint by industry associations that represent businesses with coin-accepting machines, such as the vending, amusement, and parking industries. We interviewed; (1) U.S. Mint officials and Navigant representatives to better understand how they developed their government-savings estimates; (2) officials from the Royal Canadian Mint and Royal Mint of the United Kingdom because those two entities have changed the metal composition of their coins; and (3) the six selected industry associations that developed cost estimates for the U.S. Mint. In addition to these associations, we selected and contacted five other industry organizations to understand technical aspects of coin acceptance machinery used in the industry. We selected industries using a variety of criteria, including industries that; (1) were specifically identified in the Act, such as the vending and parking industries; (2) reported sizeable cost impacts, such as the amusement park industry; and (3) rely on different coin denominations, such as the armored car industry. The information we received from interviews cannot be generalized to represent the views of the entire universe of industries that use coins, but it provides insight into how industries developed their estimates and how they could be affected

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<sup>3</sup>GAO, *GAO Cost Estimating and Assessment Guide: Best Practices for Developing and Managing Capital Program Costs*, [GAO-09-3SP](#) (Washington, D.C.: Mar. 2, 2009). The methodology outlined in this guide is a compilation of best practices that federal cost-estimating organizations and industry use to develop and maintain reliable cost estimates throughout the life of a program. The best practices were developed in conjunction with government and industry experts in the cost-estimating community and can be used to assess various types of business case analyses for smaller programs. By default, the guide also serves as a guiding principle for our auditors to ensure the development of high quality and reliable cost estimates.

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by a change in coin composition. Lastly, we determined the current options for changing coin composition. For each option, we described how each option could affect government savings and industry costs. For more information on the methodology used in our report, see appendix I.

We conducted this performance audit from March 2015 to December 2015 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

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## Background

Coins serve as a medium of exchange in everyday commerce. In 2012, Concurrent Technologies Corporation, a contractor to the U.S. Mint, estimated that there were from 355 billion to 370 billion coins in circulation—about two-thirds of them pennies.<sup>4</sup> Many of these coins are not in active circulation because people hold coins in storage containers in their homes, automobiles, or office desk drawers, among other places. However, coins in active use are accepted across the nation as payment in hand-to-hand transactions and for products and services in millions of machines ranging from vending and laundry to amusement and parking machines. These automated, unattended machines validate U.S. coins and their denominations by measuring one or more of the diameter, thickness, weight, and electromagnetic signature (EMS) of each coin.<sup>5</sup> In addition to the four primary coins in circulation—the penny, nickel, dime, and quarter—the 50-cent piece and 1-dollar coin are also considered circulating coins.<sup>6</sup>

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<sup>4</sup>Concurrent Technologies Corporation, *Alternative Metals Study* (Johnstown, PA Aug. 31, 2012). This corporation conducted an independent, comprehensive assessment of potentially and currently available metallic materials and processing methods for production of U.S. circulating coins. The results of its work supported the U.S. Mint's 2012 *Biennial Report to Congress*.

<sup>5</sup>The electromagnetic signature (EMS) is an electronic reading by a sensor, which is directly influenced by the materials and thickness of a coin.

<sup>6</sup>The U.S. Mint does not currently produce the 50-cent piece and 1-dollar coin for circulation and therefore these coins were not included within the scope of the U.S. Mint's analysis.

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The Constitution gives Congress the power to coin money, and under this authority, Congress has specified that the current metal composition of coins be as follows:<sup>7</sup>

- the penny (1-cent) is made of copper-plated zinc and consists of 97.5 percent zinc and 2.5 percent copper,<sup>8</sup>
- the nickel (5-cent) is made with an alloy of 75 percent copper and 25 percent nickel (a combination known as “cupronickel”), and
- the dime (10-cent) and the quarter (25-cent) consist of three layers of metal. The inner layer is copper and the two identical outer layers are a silver-colored alloy of 75 percent copper and 25 percent nickel. (A multi-layer coin is called a “clad coin.”)

The Federal Reserve determines the number of coins required to meet the public’s needs. Specifically, depository institutions (e.g., commercial banks and credit unions) order new coins from the Federal Reserve through an online coin-ordering system called FedLine. Then, the Federal Reserve’s Cash Product Office submits a new coin order to the U.S. Mint. In turn, the U.S. Mint produces and distributes new coins each month to the 12 Federal Reserve Banks that fulfill the orders made by the depository institutions. In general, coin production varies from year to year depending on several factors, such as public demand, the need to replace mutilated or worn coins, and the price of copper, as well as orders from the Federal Reserve to maintain its targeted inventory levels. The U.S. Mint produced about 5-billion circulating coins in 2010 and about 13-billion circulating coins in 2014.

When the cost to produce and distribute a coin is less than its face value, the federal government experiences a financial gain, creating a value known as “seigniorage”. In fiscal year 2014, the U.S. Mint realized about \$315 million in seigniorage from circulating coins. The quarter and dime resulted in seigniorage of \$406 million, whereas the nickel and penny

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<sup>7</sup>31 U.S.C. § 5112 authorizes the circulating coins that are to be produced, the wording or inscriptions that are to appear on them, and their physical characteristics, such as weight and diameter.

<sup>8</sup>31 U.S.C. § 5112(c) gives the Secretary of the Treasury authority to vary the copper and zinc alloy in the penny. According to the U.S. Mint, the Secretary of the Treasury set these percentages of zinc and copper.



resulted in a loss of seigniorage in the amount of \$91 million. Seigniorage is returned to the Treasury General Fund and reduces government’s borrowing and interest cost, resulting in a financial benefit to the government, whereas loss of seigniorage is absorbed as part of the U.S. Mint’s operating costs. Table 1 shows the amount of seigniorage from fiscal year 2010 through 2014.

**Table 1: Value of Coins Shipped, Cost to Produce Coins, and Seigniorage from Fiscal Year 2010 through 2014**

(for the penny, nickel, dime, and quarter; dollars in millions, unadjusted for inflation)

<b>Fiscal year</b>	<b>Value of coins</b>	<b>Cost to produce</b>	<b>Seigniorage</b>
2014	\$783	\$468	\$315
2013	\$578	\$425	\$153
2012	\$396	\$356	\$40
2011	\$310	\$321	(\$11)
2010	\$205	\$178	\$27

Source: GAO analysis of U.S. Mint’s annual reports. | GAO-16-177

The Act authorized the Secretary of the Treasury to conduct research and development on new metals for all circulating coins with the goal of reducing production costs. The Act also required, among other things, that the Secretary:

- consider “[f]actors relevant to the ease of use of and ability to co-circulate of new coinage materials, including the effect on vending machines and commercial coin processing equipment and making certain, to the greatest extent practicable, that any new coins work without interruption in existing coin acceptance equipment without modification;”
- “include detailed recommendations for any appropriate changes to the metallic content of circulating coins in such a form that the recommendations could be enacted into law as appropriate;”
- “to the greatest extent possible, may not include any recommendation for new specifications for producing a circulating coin that would require any significant change to coin accepting and coin-handling equipment to accommodate changes to all circulating coins simultaneously;” and
- submit a biennial report to Congress “analyzing production costs for each circulating coin, cost trends for such production, and possible

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new metallic materials or technologies for the production of circulating coins.”

The Secretary of the Treasury issued the first biennial report in December 2012 and another in December 2014. These reports summarized the U.S. Mint’s research and development efforts to identify new metallic materials or technologies for the production of circulating coins and also included information on the U.S. Mint’s outreach efforts to industry and industry cost estimates. In identifying potential new materials for circulating coins, the U.S. Mint needed to ensure that the material could be used as a viable, durable coin. After testing 29 different metal compositions for circulating coins,<sup>9</sup> the U.S. Mint has identified four viable metal compositions—a new version of the current cupronickel (copper and nickel), nickel-plated steel, multi-ply plated steel, and stainless steel.<sup>10</sup> The U.S. Mint plans to issue another report in December 2016. According to U.S. Mint officials, the 2016 report will highlight areas of further study as discussed in the *2014 Biennial Report to Congress*. The areas of study include further testing and evaluation of the new cupronickel alloy, stainless steel research and development, improvements in production, and outreach to the coin industry, among other things.<sup>11</sup>

Other countries have also taken steps to reduce metal composition of coins to reduce costs. For example, the Royal Canadian Mint and the Royal Mint of the United Kingdom have both changed the metal composition of their coins from cupronickel to steel-based coinage in an effort to reduce production costs. The Royal Canadian Mint manufactures its coins using a patented multi-ply plated steel technology. The Royal Mint produces its coins using its own plated steel technology known as aRMour® plating.

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<sup>9</sup>The U.S. Mint analyzed viable metal alternatives for the nickel, dime, and quarter. It did not consider metal changes to the penny because it has not identified any metal cheaper than zinc.

<sup>10</sup>Nickel-plated steel technology is a minting process used by the Royal Mint of the United Kingdom that plates a single layer of nickel onto a low-carbon steel core. Multi-ply plated steel technology is used by the Royal Canadian Mint and typically uses 3 surface layers—nickel/copper/nickel—electroplated on a low-carbon steel core. Austenitic stainless steel—the 3XX-series—is a metal with non-ferromagnetic properties.

<sup>11</sup>For the purposes of this report, the term “coin industry” includes those businesses that use coin acceptance machines, such as the vending industry, and those that handle substantial amounts of coins, such as the armored car industry.

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A variety of businesses rely on coins. Some industries sell products or services through the use of coin machines, such as vending and coin-operated laundry machines. According to the vending machine industry, it generally sells products using modern, technologically advanced coin machines that validate and accept many types of circulating coins as well as dollar bills. Its members include well-known, large corporations. In contrast, representatives from the coin-operated laundry industry stated that the industry is comprised of small “mom-and-pop” business owners and operators, provides services using mechanical technology, and depends heavily on the quarter. Representatives from the amusement industry also stated that their industry depends heavily on the quarter for playing games, billiards, and juke-boxes. Businesses in the amusement industry range from large national chains to small owners and operators. Another type of industry that deals with coins is the armored car industry. According to this industry, it sorts, counts, wraps, and transports all denominations of circulating coins from Federal Reserve Banks to commercial banks and other privately owned businesses. This industry is dominated by four large armored car carriers. Finally, manufacturers that make coin acceptance and handling equipment support the entire coin industry.

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## The U.S. Mint’s Analysis Indicates Potential for Government Savings from Changing the Composition of Coins




The U.S. Mint’s Analysis of  
Viable Metal Alternatives  
Shows Potential for  
Savings

The U.S. Mint’s analysis estimates that the government could potentially save from about \$8 million to about \$39 million per year through different changes in coin composition to the nickel, dime, and quarter.<sup>12</sup> The U.S. Mint developed four alternatives for coin composition and estimated the savings for each alternative (see fig. 1).

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<sup>12</sup>U.S. Mint savings estimates were updated during the course of the review and are not necessarily the same numbers that are reflected in the U.S. Mint’s *2014 Biennial Report to Congress*.

**Figure 1: U.S. Mint’s Annual Estimates of Potential Government Savings Resulting from Changes to the Composition of U.S. Coins, by Denomination and by Viable Metal Alternative**

Coin denomination		2014 baseline costs	Viable coin composition alternatives			
			Seamless	Co-circulating		
			Copper and nickel	Multi-ply plated steel	3XX stainless steel	Nickel plated steel
 <b>Nickel (\$0.05)</b>	Total production unit cost	\$0.0809	\$0.0773	\$0.0547	\$0.0590	\$0.0603
	Total production cost (millions)	\$97.970	\$93.610	\$66.242	\$71.449	\$73.023
	Annual estimated savings (millions)	–	\$4.360	\$31.728	\$26.521	\$24.947
 <b>Dime (\$0.10)</b>	Total production unit cost	\$0.0391	\$0.0385	\$0.0358	Not viable <sup>b</sup>	\$0.0361
	Total production cost (millions)	\$86.919	\$85.586	\$79.583		\$80.250
	Annual estimated savings (millions)	–	\$1.334	\$7.336		\$6.669
 <b>Quarter (\$0.25)</b>	Total production unit cost	\$0.0895	\$0.0882	Not viable <sup>a</sup>	Not viable <sup>b</sup>	Not viable <sup>a</sup>
	Total production cost (millions)	\$150.629	\$148.441			
	Annual estimated savings (millions)	–	\$2.188			
<b>All three coins</b>	<b>Total annual estimated savings (millions)</b>	–	<b>\$8</b>	<b>\$39</b>	<b>\$27</b>	<b>\$32</b>

Source: GAO analysis of U.S. Mint data. | GAO-16-177

<sup>a</sup>U.S. Mint testing found that multi-ply plated and nickel plated steel are not viable alternatives for the quarter due to the potential for counterfeiting and foreign coin substitution.

<sup>b</sup>U.S. Mint testing found that monolithic stainless steel was not a viable alternative for the dime and quarter due to the potential for counterfeiting.

The U.S. Mint’s analysis shows that changing to a new version of a copper and nickel combination (cupronickel) could potentially save the government about \$8 million per year, based on 2014 production costs, and should not affect industry. This change is known as the “seamless” alternative because it would not significantly change the characteristics of the nickel, dime, or quarter. The savings would result from a change in metal costs alone, specifically (1) increasing the amount of copper in the nickel and the outer clad layer of the dime and the quarter from 75 percent to 77 percent and decreasing the amount of nickel, which is more expensive, from 25 percent to 20 percent, and (2) adding manganese to the coins. The seamless alternative is designed to have the same diameter and EMS characteristics and nearly the same weight as the current cupronickel composition. According to the U.S. Mint, this alternative would not require any changes to coin acceptance machines and would not affect industry. As of September 30, 2015, the U.S. Mint was conducting further testing of another version of this alloy that substitutes zinc or zinc and manganese for some of the nickel, to help

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ensure that the alloy has the same characteristics as the current nickel and would not require changes to coin acceptance machines.

The U.S. Mint's analysis also shows that the largest savings the government could potentially achieve is about \$39 million per year by changing the coin composition of the nickel and dime to multi-ply plated steel. This type of change is referred to as a "co-circulating" alternative because different types of coin compositions for the same coin denomination would circulate together in the economy for 30 years or more.<sup>13</sup> Under this co-circulating alternative, savings would result from both metal changes (as steel is less expensive than copper or nickel) and production changes. According to U.S. Mint officials, their metal suppliers would supply coin "blanks" for multi-ply plated steel coins, thereby eliminating the need for the U.S. Mint to make its own blanks.<sup>14</sup> Currently, suppliers provide sheets of metal that the U.S. Mint uses to produce coin blanks. A change to steel-based coins would require the coin industry to make modifications to current coin acceptance machines to recognize and accept both new and existing coins, because the new coins would have a different weight and EMS than existing coins and would also be magnetic.

The U.S. Mint had originally included the quarter in its savings estimates for a co-circulating coin change. When including the quarter, the U.S. Mint had estimated that the government could save \$83 million per year by changing the quarter, nickel, and dime to multi-ply plated steel.

In October 2015, U.S. Mint officials told us that they determined that neither multi-ply plated steel nor the nickel-plated steel compositions were viable for the quarter due to security concerns.<sup>15</sup> Specifically, as the use

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<sup>13</sup>In order for coins to not co-circulate, the "old" cupronickel coins would have to be removed from circulation. Under current U.S. law, there is no provision for this type of action. According to U.S. Mint officials, removing old coins would not necessarily lead to cost savings, as the value of recovered coins may need to be paid back to the Federal Reserve, which issued the coins.

<sup>14</sup>A coin blank is a round metal disk of metal on which a coin design is ready to be stamped.

<sup>15</sup>We did not evaluate the Mint's decision that a steel quarter is not viable because evaluating the Mint's technical decisions was beyond the scope of this review.

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of steel coins has increased around the world, the U.S. Mint determined that there is too great a risk that the size, weight, and EMS of any steel-based U.S. quarter may be close to that of a less valuable foreign coin. According to Mint officials, this disparity may result in fraud because machines would not be able to differentiate between the U.S. quarter and lower-value foreign coins. According to U.S. Mint officials, it is viable to change the nickel and dime to multi-ply plated steel because these coins are lower in value and therefore do not provide a similar incentive to counterfeiters.

The Act provides the parameters that the U.S. Mint used to direct its research and development and evaluate the impact to industry as it developed estimates. For example, the Act limits the U.S. Mint to considering metallic materials during its research and development for co-circulating alternative coinage. Specifically, the Act specifies that metallic materials be tested for coinage, and this testing prevents the U.S. Mint from considering less expensive materials and nonmetallic alloys that could be suitably fabricated as coins and limits the co-circulating alternatives. Additionally, the U.S. Mint did not include metallic changes to the penny because the U.S. Mint could not identify a less expensive metal for the penny. In its 2012 biennial report, the U.S. Mint reported that while the penny costs more to produce than its face value, there is no viable metal alternative that is cheaper than zinc. Representatives from a raw material supplier, and consulting firm told us that they agreed with the U.S. Mint's assessment. The Act also specified that any proposed changes may not allow for greater risk of fraud from counterfeiting or substituting cheaper foreign coins. Finally, according to U.S. Mint officials, the Act's language on minimizing the effect on vending machines and commercial coin processing equipment led the U.S. Mint to pursue research on a seamless alternative as well as a co-circulating alternative.

In addition, the U.S. Mint's analysis did not include information on how the organization would transition from the current coin composition to a new coin composition. For example, the U.S. Mint did not determine the disposal costs of equipment that would no longer be used if coin composition changed or consider potential changes to its workforce. According to officials, the U.S. Mint has improved its internal processes through a separate effort. Specifically, according to U.S. Mint officials, the U.S. Mint reduced plant overhead by 7 percent and general and administrative costs by 18 percent from between 2009 to 2014; reduced

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employee shifts—from 3 to 2 shifts per day—at the two Mints that produce circulating coins; and streamlined its die- manufacturing process.<sup>16</sup>

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## The U.S. Mint’s Cost- Estimating Process Does Not Fully Align with Best Practices

Although these estimates can provide an understanding of the general magnitude of potential government savings, our analysis found that the U.S. Mint’s cost-estimating process and resulting analyses are limited because they did not fully align with best practices for estimating costs, as outlined in the *Cost Guide*. Without following best practices, the U.S. Mint’s estimates may not be reliable.

The *Cost Guide* includes a 12-step process to develop a reliable cost estimate. These best practices are the basis for developing high-quality, reliable cost estimates and help ensure that the cost estimates are comprehensive, well documented, accurate, and credible.<sup>17</sup> For example, following these practices should result in cost estimates that can, among other things, be replicated and updated. According to the *Cost Guide*, these best practices can guide government managers as they assess the credibility of a cost estimate for decision-making purposes for a range of programs. Of the 12 steps in the *Cost Guide*, our analysis found that the U.S. Mint’s cost-estimating processes fully met 1, partially met 7, minimally met 3, and did not meet 1 of these 12 steps. More detailed information describing how the U.S. Mint’s cost estimating process aligned with the *Cost Guide* can be found in appendix II. In summary:

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<sup>16</sup>The U.S. Mint operates five mint facilities that are located in Philadelphia, Pennsylvania; Denver, Colorado; San Francisco, California; West Point, New York; and Fort Knox, Kentucky. Only the Philadelphia and Denver mint locations are responsible for manufacturing circulating coins for general use.

<sup>17</sup>A cost estimate created using the best practices exhibits four broad characteristics – comprehensive, well-documented, accurate, and credible. An estimate is comprehensive if it has enough detail to ensure that cost elements are neither omitted nor double counted. All cost-influencing ground rules and assumptions are detailed in the estimate’s documentation. An estimate is well-documented if it is thoroughly documented, including source data and significance, clearly detailed calculations and results, and explanations for choosing a particular method or reference. An estimate is accurate if it is unbiased, not overly conservative or overly optimistic, and based on an assessment of most likely costs. An estimate is credible if any limitations of the analysis because of uncertainty or bias surrounding data or assumptions are discussed.

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- Fully met: The U.S. Mint fully met one step. This step was to brief its management as part of its review process and obtain and document management's approval of the estimate.
  - Partially met: The U.S. Mint partially met 7 steps of the cost-estimating process. These steps generally occurred during the cost assessment portion of the cost-estimating process. To its credit, the U.S. Mint partially met the steps of (1) defining the estimate's purpose, (2) developing the estimating plan using technical staff, (3) defining the program characteristics, (4) determining the estimating structure from the cost of raw materials to overhead, (5) obtaining the data from the U.S. Mint's cost-accounting system, (6) developing the point estimate and comparing it to an independent cost estimate, and (7) updating the estimate. For example, the U.S. Mint partially met defining the purpose of the savings estimate because the U.S. Mint defined the scope of the estimate but did not fully consider all costs. Specifically, the U.S. Mint did not include about \$5.7 million in one-time expenses to conduct research, development, and testing of viable metals and did not consider expenses to dispose of equipment that may no longer be needed if a decision is made to produce steel-based coins.
  - Minimally met: The U.S. Mint minimally met 3 steps that generally occurred during the analysis of the cost-estimating process. These steps include (1) conducting a sensitivity analysis, (2) documenting the estimate, and (3) identifying ground rules and assumptions. While U.S. Mint officials discussed a sensitivity analysis, it was not conducted. Without a fully documented sensitivity analysis, the U.S. Mint cannot determine how a change in inputs—such as the price of metal—would affect the potential for savings because the cost of metal is an important factor in the U.S. Mint's overall costs to produce coins. Also, when documenting estimates, the U.S. Mint used 2014 metal prices to determine its estimates. However, metal prices change over time. For example, from 2011 to 2015, the price of copper ranged from \$2.24 per pound to \$4.58 per pound. Such a change in metal prices impacts the U.S. Mint's costs and therefore can significantly impact its savings estimates. Finally, certain assumptions were not made or documented since the U.S. Mint's savings estimate did not project savings into the future, but rather all analyses were based on one year.
  - Not met: The U.S. Mint did not meet the step that required it to conduct a cost-risk and uncertainty analysis. These analyses examine a broad range of factors, such as unforeseen technical problems or



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changes in staff availability and expertise, that could possibly occur and would affect the estimate.

The U.S. Mint's cost-estimating process did not fully align with the best practices described in the *Cost Guide* and therefore the estimates may not be reliable as a precise indication of government savings. However, the efforts taken by the U.S. Mint nonetheless provide an understanding of the general magnitude of government savings. We discuss later in this report how the magnitude of estimated government savings compares to the magnitude of estimated industry costs to illustrate the scale and relationship between estimates of government savings and industry costs.

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### Other Estimates of Government Savings Are Narrow in Scope

Our review of other estimates of potential government savings found these estimates to be narrow in scope. For example, a 2012 Navigant study that was commissioned by a supplier of coin material estimated that the U.S. government could achieve savings of up to \$207.5 million per year by changing the current coin compositions of the nickel, dime, and quarter to multi-ply plated steel, which is the same composition used in Canadian coins.<sup>18</sup> However, by design, the estimate is not comprehensive because it does not account for other costs associated with making this change such as production, processing, transportation, and new equipment costs as well as licensing fees to use multi-ply plated steel technologies. In addition, this study was limited in scope because it was not designed to be a comprehensive cost-benefit analysis of government savings and industry costs. Generally, according to guidance from the Office of Management and Budget (OMB), changes in federal programs should be informed by an assessment of whether the benefits exceed the costs.<sup>19</sup> Navigant determined how the use of multi-ply plated steel that is used by the Royal Canadian Mint could be applied to U.S. government coins to potentially achieve raw material savings. Navigant did not make comparisons to other seamless or other co-circulating metal-composition options and did not consider how a statutory requirement, such as minimizing industry conversion costs, might be applied.

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<sup>18</sup>Navigant, *Potential Benefits to the United States Mint From Changing the Metallic Content of Its Vended Coins to Multi-Ply Plated Steel* (February 2012).

<sup>19</sup>See Office of Management and Budget *Circular No. A-94* (Oct. 29, 1992).

Another 2012 Navigant study explored potential government savings by eliminating the penny but did not consider how a change in metal composition other than multi-ply plated steel for the other coins could be made to reduce costs and achieve savings.<sup>20</sup> This study concluded that eliminating the penny would not result in government savings, as more nickels may be required and the government also loses money on the production of nickels.

## Industry Costs Could Be Significant, but Estimates May Be Overstated

### Industry Estimates Find Significant Costs Associated with Changes in Coin Composition

The six selected industry associations that provided cost estimates to the U.S. Mint stated that there would be significant cost impacts ranging from \$2.4 billion to \$10 billion. These costs result from modifying an estimated 21.9-million coin acceptance machines as a result of potential changes to the metal composition of coins, as shown in table 2. Industry associations developed these cost estimates and provided them to the U.S. Mint in response to an April 2014 *Federal Register* notice.<sup>21</sup> The U.S. Mint reprinted the estimates in its December 2014 *Biennial Report to Congress*.

**Table 2: Industry Estimates of the Number of Coin Machines and Costs from Modifying Coin Composition, by Selected Industry (Figures Are Rounded)**

Industry	Low	High	Estimated number of coin machines
Amusement park	\$1 billion	\$5 billion	10 million
Vending	\$700 million	\$3.5 billion	7 million
Amusement machine	\$100 million	\$500 million	1 million
Coin laundry	\$156 million	\$470 million	1.6 million

<sup>20</sup>Navigant, *Impact of Eliminating the Penny on the United States Mint's Costs and Profit in Fiscal Year 2011* (April 2012). The financial effect of eliminating the penny was beyond the scope of this report.

<sup>21</sup>79 Fed. Reg. 19971 (Apr. 10, 2014).

Industry	Low	High	Estimated number of coin machines
Parking	\$400 million	\$600 million	2 million
Armored car	\$410,000	\$1.650 million	5,800
<b>Estimated total industry cost</b>	<b>\$2.4 billion</b>	<b>\$10 billion</b>	<b>21.9 million</b>

Source: GAO review of industry estimates provided to the U.S. Mint. | GAO-16-177

The cost estimates in table 2 presuppose a metal change from cupronickel to steel for the nickel, dime, and quarter as well as the need to accept both current and new coins co-circulating together. These estimates reflect a level of uncertainty about the dimensions (diameter and thickness) and other technical specifications of any new coins. For example, the vending industry estimated a cost impact of at least \$700 million—a cost of at least \$100 per machine—to update the software in 7-million modern, electronic coin machines to accept new metallic coins with different EMSs. The vending industry representative we interviewed said the low estimate assumes little or no changes to the dimensions of new coins, and therefore costs for mechanical hardware changes are not estimated, but presumed are changes in the EMS or weight due to a metal change. Two of the six industry associations we contacted, as well as a coin machine manufacturer and the contractor for the U.S. Mint, told us that software modification costs are primarily driven by labor costs to update software, not the software cost itself. That is, businesses would have to hire a certified technician to update the software on every electronic coin machine in order for that machine to accept any new coins that do not have the same properties as the current coins that would remain in circulation. These representatives stated that updates would typically take less than an hour and each service call would cost up to \$100. The vending industry’s high cost estimate of \$3.5 billion reflects changes to coin dimensions as well as EMS specifications. According to a vending industry representative, changes in coin dimensions would require the vending industry to update the software as well as remove the hardware associated with coins within the vending machine and replace it with redesigned and expanded hardware in order to accept both current and new coins with different dimensions.

The situation for the amusement industry is similar to that of the vending industry. The amusement industry estimated costs ranging from \$100 million to \$500 million depending on the need to either update the software on the estimated 1-million amusement machines, or remove and replace their coin machines with new machines designed to accept both

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current and new coins with different dimensions, which would be more costly. For the owners and operators of pool tables and coin laundries that use older mechanical (not electronic) coin machines, their cost estimates reflect a need to remove and replace their machines with new machines that could accept both current coins as well as steel-based coins, yet reject steel-based slugs.

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## Industry Cost Estimates May Be Overstated

We reviewed industry estimates and identified factors that indicate that these estimates may be overstated:

- The published cost estimates do not account for the U.S. Mint's position not to alter the dimensions of coins. According to U.S. Mint officials, new coins would retain the same dimensions as current coins. Consequently, the high cost estimate of \$10 billion may be overstated because it is based on the need for mechanic hardware changes in machines to accommodate new coins with different dimensions. The low cost estimate of \$2.4 billion assumes no changes to coin dimensions.
- The cost estimates do not account for the U.S. Mint's position to not alter the quarter to a steel-based coin. Specifically, these published estimates assumed that the characteristics of the quarter would change, but U.S. Mint officials have determined that it is not viable to produce a steel-based quarter. According to U.S. Mint officials, they are currently only exploring changing the cupronickel composition of the quarter, which would not require any modification to a machine that accepts only quarters.
- The number of coin machines needing modifications may be overstated. Industry costs to modify machines are proportional to the number of coin machines needing modifications. As the number of coin machines decreases, these costs would also decrease. Two examples illustrate that the number of coin machines may be overstated. First, the vending association reported in its 2014 written response to the U.S. Mint that there were about 7-million food, beverage, and product vending machines in the United States. However, a 2015 study developed by the vending association, in partnership with a food research and consulting firm, reported that there are now 4.5-million vending machines—a decrease of about 36 percent. A lower actual number of vending machines would translate to a decrease in estimated cost from \$700 million to about \$450 million—assuming the cost of \$100 per machine. Second, in a 2014 written response to the U.S. Mint, the amusement park industry

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association—whose members include family entertainment centers and arcades, among others—stated that there are about 10-million coin-operated machines in the United States and that changes in the metallic content of coins would result in a cost impact ranging from \$1 billion to \$5 billion. However, our review found the its cost estimate may have double-counted coin machines from the larger amusement sector, which also represents family entertainment centers and arcades. The industry did not provide enough detail to determine the scope and breadth of its coin machine estimate.

- The parking industry is shifting from coin-operated to coinless parking meters. According to a parking industry representative, the number of parking meters is decreasing due to a trend from single-space, coin-operated, parking meters to multi-space, smart meters that allow payment by credit card or phone. Because of the many benefits associated with smart meters, the representative believes that within 15 years, nearly all parking meters will no longer accept coins. However, the parking industry estimated its costs by estimating that 2-million parking meters would need to be updated to accept new coins. According to a parking industry representative, this information was based on data collected from an informal phone survey in 2007 and does not reflect industry changes since then.

According to U.S. Mint officials, they did not independently verify industry cost estimates to help ensure that they are reliable. Rather, officials said that they obtained and reported industries' written responses to the U.S. Mint's *Federal Register* notice, dated April 10, 2014, which requested estimates from industry within 60-days after the notice was published. Although we interviewed industry representatives to understand their cost estimates, we did not independently verify the estimates as this was outside the scope of our work.

One foreign mint, which has changed the metal composition of coins found that actual industry costs were less than industry estimated. Specifically, a Royal Mint memorandum stated that initial vending industry estimates to accept new coins in the United Kingdom were about £40 million (about \$60 million).<sup>22</sup> However, after the United Kingdom had completed its transition to steel coins, studies showed that actual conversion costs were about £17 million (about \$26 million), or about 58

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<sup>22</sup>Assume an exchange rate of £1 = \$1.50

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percent less than estimated. According to a Royal Canadian Mint official, the Royal Canadian Mint did not compare industry cost estimates to the actual costs incurred.

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### Industry Has Little Incentive to Support Coin Composition Changes and Alternatives to Reduce Costs

In written responses to the U.S. Mint's *Federal Register* notice, two of the six industry associations we contacted explicitly said that they do not support changes to the metallic composition of any coins. Specifically, representatives for industries that handle or accept coins of all denominations—such as the banking, armored carrier, and vending industry—called for no changes to be made to the metallic content of coins because such a change would require these industries to spend money to update their coin machines. Representatives for industries that accept certain coin denominations—such as the parking, amusement, and coin laundry industries that rely primarily on the quarter—were not opposed to metallic changes as long as changes were not made to the quarter. These representatives told us that changing to a steel-based quarter would complicate their business operations because these industries tend to have mechanical, rather than electronic, coin machines that currently use magnets to reject steel-based materials, commonly called slugs. A coin machine manufacturer that updates or sells machines to other businesses was generally supportive of potential changes to circulating coins. Five industry associations we contacted said that if new metallic coins are introduced, the changes should be seamless to avoid any cost impact to industry.

Three industry associations we spoke with stated there is little benefit to phasing in the introduction of new coins. Representatives from these associations explained that even if the U.S. Mint introduced new coins at a rate of 3 percent per year (thereby taking a number of years for a substantial percentage of new coins to be in circulation), their industries would take immediate action to modify their equipment because they would not want to lose any potential revenue from customers who could not use new coins in unmodified machines. They believed that those customers would be unlikely to return to machines that rejected their coins due to a perception that the machines were faulty.

Representatives from the six associations that provided cost estimates to the U.S. Mint generally stood by their estimates and said that the assumptions on which their cost estimates are based are reasonable. Nonetheless, due to the Act's mandate that the conversion costs to industry be minimized, we discussed various potential changes in business practices with some industry representatives to determine if

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implementation of these practices could reduce costs. In general, they did not believe these practices would reduce costs or identify other practices that could reduce costs.

Gaining Efficiencies by Updating Multiple Machines at the Same Location

Like other industries that provided cost estimates, the vending industry estimated its potential cost by multiplying the total number of coin machines by the cost to update each machine. Because two or more vending machines (one food and one drink machine) are often at the same location, the total cost to update the software on the machines may be less if a technician would be able to modify multiple vending machines for the cost of one service call.<sup>23</sup> When we asked its representative whether it would be reasonable for businesses to update the software on multiple machines at the same location, the representative said that costs may be reduced by efficiencies in servicing machines at the same time, but cautioned that the overall cost reduction was not large. The representative was not able to provide other business practices that would result in a lower cost estimate.

Updating Machines during Routine Maintenance

Representatives from three of the six industry associations we contacted said that it was not a viable business practice to update their machines during routine maintenance cycles, rather than scheduling special one-time service calls to accommodate new coins. Amusement industry representatives said that they rarely replace coin acceptance machines because their coin machines are built and designed to work for decades without routine maintenance. Similarly, the coin laundry representatives said there would be few opportunities for updating and replacing of coin machines since washers and dryers tend to be in-service without failure for a minimum of 12 to 15 years. The vending industry representative said that drivers who stock vending machines are not trained, nor is it in their skillset, to update software on vending machines. Representatives from these industries said that if and when a decision is made to change the metal composition of coins, they would take immediate actions to modify their machines because doing nothing would result in lost revenue.

Moving to a Coinless Business Model

Given a potential cost to modify coin machines, we interviewed four selected industry associations to determine whether their costs would be lower if they moved to a coinless business model that accepts various

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<sup>23</sup>The Concurrent Technologies Corporation, *Alternative Metals Study* states that, on average, three vending machines are located at the same site.

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forms of electronic payments, not coins. Representatives from the coin laundry and amusement machine industry association told us that moving to a coinless business may increase, not decrease, costs because of the substantial capital investment needed to install the necessary infrastructure (i.e., payment mechanisms, Internet, modem, Wi-Fi, and associated wiring) to move to a coinless system. For example, amusement industry representatives said that a small number of entertainment businesses have switched to coinless card readers at large venues having 25 or more game machines, but it is not financially viable for some business owners with a small number of amusement machines in multiple locations to make this investment. Additionally, two representatives from the coin laundry industry stated that their industry serves individuals who are often “unbanked.” These unbanked individuals who do not have or use bank accounts, debit cards, and other banking services may prefer using only coin-operated laundry machines rather than coinless-operated laundry systems.

#### Using Change Machines to Reduce the Need to Alter Other Machines

In lieu of modifying all of the coin machines to accept new coinage, we interviewed representatives from two selected industry associations to determine whether a viable business practice would be to install change machines that dispense current coins. Representatives from both industry associations told us that buying and installing change machines would not be a cost-effective alternative to modifying their existing coin machines due to procurement and installation costs as well as any maintenance and servicing costs associated with these change machines.

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#### Coin Compositions That Increase Government Savings Also May Increase Industry Costs

Although the estimates of potential government savings and industry cost may not be precise, the estimates provide enough information to show that metal compositions that increase the potential government savings may also increase the potential industry costs. As discussed previously, the U.S. Mint has determined that it is not viable to change the quarter to a steel-based coin. As a result, the potential cost impact to industry is greatly reduced. Specifically, industries that only accept the quarter—such as the coin laundry and amusement industries— would not incur any costs if the quarter did not change. Table 3 shows options for changing coin composition and the potential government savings and industry cost impact of each option. These options do not include the possibility of making no changes to the current coin composition, which would result in no government savings and no costs to industry.



**Table 3: Coin Composition Changes for Certain Denominations and the Potential Annual Savings for Government and One-Time Cost Impacts for Industry, as of October 2015**

Option	Coin composition change	U.S. Mint estimated annual government savings	One-time industry cost impact
Co-circulating Options	1. Change THE NICKEL AND DIME to either a multi-ply or nickel-plated steel composition.	\$32 million to \$39 million	Cost impact to industries, such as vending, parking, and armored car that accept the nickel and dime.
	2. Change ONLY THE NICKEL to either a multi-ply plated steel, stainless steel, or nickel-plated steel composition.	\$25 million to \$32 million	Cost impact to industries, such as vending, parking, and armored car that accept the nickel.
Seamless Option	3. Increase the percentage of copper in the NICKEL, DIME, AND QUARTER.	\$8 million	None

Source: GAO Analysis of U.S. Mint data. | GAO-16-177

The first option calls for changing the nickel and dime to a steel-based coin (either multi-ply or nickel-plated steel). The U.S. Mint estimates that this option could save the government from \$32 million to \$39 million per year. Using U.S. Mint data, we estimate that if these savings were consistently realized over 10 years, the savings would be from \$320 million to \$390 million.<sup>24</sup> However, coin machines for some industries, such as the vending industry, would require a one-time update to accept these new nickels and dimes because the properties of these coins would change. Industry costs are unknown for this option because industry estimates reflect the cost to change all coin acceptance machines for all denominations. Under this option, there may be significant costs for those industries that accept the nickel and the dime (about \$1.1 billion to about \$4.1 billion for the vending, parking, and armored car as shown in table 2). However, the costs would likely be less than currently reported.

The second option is to change only the nickel to a plated or stainless steel coin. The U.S. Mint estimates that this option could save the government from \$25 million to \$32 million per year. As with option 1, there may be significant costs for a few industries that accept the nickel, but overall industry costs would likely be less than currently reported (about \$1.1 billion to about \$4.1 billion for the vending, parking, and armored car industries, as shown in table 2). It is also unclear if some industries would choose not to modify their coin acceptance machines if only the nickel would change. Some owners of coin acceptance machines

<sup>24</sup>For simplicity, we did not apply OMB discount rates to the estimated government savings over 10 years.

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may decide to no longer accept the nickel instead of updating their coin acceptance machines to accept the new nickel.

The third option—the seamless option—would increase the amount of copper in the nickel, dime, and quarter. The U.S. Mint estimates that the government could save about \$8 million per year. The U.S. Mint is conducting research to ensure it could reduce the amount of nickel in each coin and increase the amount of copper while ensuring that the coins work in current coin acceptance machines. The U.S. Mint is expected to report on the results of this research in 2016. If the new coins worked seamlessly in current machines, it is expected that there would be no costs to industry.

As previously discussed, the Act requires that any new coins work without interrupting existing coin acceptance equipment “to the greatest extent practicable.” In addition, it requires that any recommendations to change coin composition may not have “significant” changes to coin acceptance machines. The U.S. Mint has not yet determined how to quantify “significant” change and “to the greatest extent practicable” to determine what, if any, recommendations could be made to change the composition of coins that would be authorized under the Act. The Act does not set a time frame for providing recommendations to Congress and the U.S. Mint has not established a time frame for making any recommendations. However, U.S. Mint officials told us that if and when the Department of the Treasury makes any recommendations to Congress, the U.S. Mint and Treasury officials will ensure that the recommendations are within the framework of the Act.

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## Agency Comments and Our Evaluation

We provided a draft of this report to Secretary of the Treasury for review and comment. In its comments, the U.S. Mint expressed concerns regarding two issues—our use of the *Cost Guide* to assess the U.S. Mint’s cost-estimating process and our lack of discussion regarding a 2012 report by Concurrent Technologies Corporation (CTC). The U.S. Mint also provided additional context regarding the Act’s requirements that the U.S. Mint consider the effect on industry of any coin change.

Regarding our use of the *Cost Guide*, the U.S. Mint took exception to our statement that the U.S. Mint’s cost estimates may not be reliable because they did not consistently follow the best practices outlined in the *Cost Guide*. The U.S. Mint stated that there is no requirement for agencies to use the *Cost Guide* and that it is not intended for use on non-capital, operational changes such as manufacturing coinage. The U.S. Mint also

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stated that manufacturing coinage is covered under the *Statement of Federal Financial Accounting Standard 4 (SFFAS 4)*, which the U.S. Mint used in developing its cost estimates. While we agree that there is no requirement for agencies to use the *Cost Guide*, the guide consists of best practices that can guide government managers as they assess the credibility of a cost estimate. In addition, *SFFAS 4* primarily refers to fundamental elements of managerial cost accounting rather than cost analysis and estimating. In our view, the *Cost Guide* is the most appropriate criteria to assess the reliability of cost estimates. The *Cost Guide* includes best practices, from the private and public sectors, in cost estimating for capital assets. A coin is produced using capital equipment and is a physical asset. Based on all of these factors, we continue to assert that the *Cost Guide* is both sufficient and reasonable criteria for assessing the U.S. Mint's cost-estimating procedures.

In its letter, the U.S. Mint also stated that our report should have discussed a 2012 report by CTC. We used this report to inform our assessment of the U.S. Mint's cost-estimating process and interviewed CTC representatives. However, the U.S. Mint's *2014 Biennial Report to Congress* contained both updated cost estimates on viable metal alternatives and updated information from industry stakeholders. As a result, we obtained information on the U.S. Mint's cost estimates from that report and reflected them in our report.

Regarding the Act's requirement to consider the effect on industry of any coin change, the U.S. Mint emphasized that it has analyzed the Act in its entirety, including the statutory provisions that require special considerations for the vending industry regarding any recommendations for new metal coin compositions. The U.S. Mint also stated that it will be important to provide a current analysis of the effect on industry when the U.S. Mint is ready to recommend new coinage materials to Congress because technology used by the industry is constantly changing. The U.S. Mint also provided technical comments, which we incorporated as appropriate. The U.S. Mint's comments are reproduced in appendix III.

As agreed with your offices, unless you publicly announce the contents of this report earlier, we plan no further distribution until 30 days from the report date. At that time, we will send copies to the appropriate congressional committees and the Secretary of the Treasury. In addition, the report will be available at no charge on GAO's website at <http://www.gao.gov>.

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If you or members of your staff have questions about this report, please contact me at (202) 512-2834 or [rectanusl@gao.gov](mailto:rectanusl@gao.gov). Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made major contributions to this report are listed in appendix IV.

A handwritten signature in black ink that reads "Lori Rectanus". The signature is written in a cursive style with a large, looping initial "L".

Lori Rectanus  
Director, Physical Infrastructure Issues

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# Appendix I: Objectives, Scope, and Methodology

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We addressed the following questions: (1) What is known about potential government savings from changes to the metal composition of coins? (2) What is known about potential industry costs from changes to the metal composition of coins? (3) How potential coin composition options could affect government savings and industry costs?

To determine what is known about the potential government savings from changes to the metal composition of circulating coins, we reviewed savings estimates reported by the U.S. Mint in its December 2012 and 2014 biennial reports to Congress, which were required by the Coin Modernization, Oversight, and Continuity Act of 2010 Act (the Act). These estimates identified savings by coin denomination (nickel, dime, and quarter) and by alternative metals (cupronickel and steel-based alternatives) when compared to fiscal year 2014 actual costs. We also reviewed the Concurrent Technologies Corporation study on alternative metals conducted under contract with the U.S. Mint. We interviewed U.S. Mint officials to understand (a) the rationale for not considering metal alternatives to the penny; (b) the purpose, data sources, methodology, and assumptions used in developing savings estimates; and (c) the process followed in developing these costs estimates. We compared the U.S. Mint's cost-estimating process with best practices. Specifically, the *GAO Cost Estimating and Assessment Guide (Cost Guide)* identifies best practices that represent work across the federal government and are the basis for a high-quality, reliable cost estimate.<sup>1</sup> We analyzed the extent to which the cost-estimating process used by the U.S. Mint to develop these cost and savings estimates followed the 12-step process described in cost estimating best practices—and assigned each step with a rating of

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<sup>1</sup>GAO, *GAO Cost Estimating and Assessment Guide: Best Practices for Developing and Managing Capital Program Costs*, [GAO-09-3SP](#) (Washington, D.C.: Mar. 2, 2009). The methodology outlined in this guide is a compilation of best practices that federal cost-estimating organizations and industry use to develop and maintain reliable cost estimates throughout the life of a government program. The best practices were developed in conjunction with government and industry experts in the cost-estimating community and can be used to assess various types of business case analyses for smaller programs. By default, the guide also serves as a guiding principle for our auditors to ensure the development of high-quality and reliable cost estimates.

not met, minimally met, partially met, substantially met, or fully met.<sup>2</sup> We also held detailed discussions with U.S. Mint officials and reviewed their documentation to identify key factors that could affect the potential costs and savings such as changes in coin production or workforce and operational changes that may not have been included directly in the estimates. We shared our *Cost Guide*, the criteria against which we evaluated the Mint's savings estimates, and our preliminary findings with U.S. Mint officials. When warranted, we updated our analyses based on the agency response and additional documentation provided to us. Finally, we corroborated our analyses in interviews with U.S. Mint officials responsible for developing the savings estimates. In addition, we reviewed two other reports prepared by Navigant Consulting—a global, independent consulting firm—under contract from Jarden Zinc—a material supplier to the Royal Canadian Mint. These reports contained cost-savings estimates based on (a) producing the nickel, dime, and quarter using multi-ply plated steel—the material currently used by the Royal Canadian Mint for its coin denominations—and (b) costs estimates should the U.S. Mint eliminate the penny. We interviewed the authors of these reports to better understand the purpose, scope, and methodology used in developing these estimates. We did not assess the reliability of the Navigant cost estimates using GAO best practices because this assessment was not within the scope of the review.

To determine what is known about potential industry costs from changes to the metal composition of coins, we reviewed all 20 industry stakeholder's written responses that were reprinted in the December 2014 biennial report. The U.S. Mint obtained these responses through an April 10, 2014 *Federal Register* notice in which it solicited written responses from industry on the impacts of changing the metal composition of circulating coins. To focus our review, we selected a non-generalizable sample group of 11 industry stakeholders. See table 4. We made our selection using a variety of criteria—such as a mix of industries (manufacturing, logistics, and commerce); being specifically identified in the Act; industries that reported sizeable cost impact; the size of industry;

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<sup>2</sup>Not met means the U.S. Mint provided no evidence that satisfies any of the elements of the best practice; minimally met means the U.S. Mint provided evidence that satisfies a small portion of the elements of the best practice; partially met means the U.S. Mint provided evidence that satisfies about half of the elements of the best practice; substantially met means the U.S. Mint provided evidence that satisfies a large portion of the elements of the best practice; and fully met means the U.S. Mint provided complete evidence that satisfies the elements of the best practice.

and mix of coin denominations, among others. This resulted in three stakeholders coming from the coin-machine manufacturing industry and a raw material supplier, two from the logistics industry, and six from the commerce industry.

**Table 4: Industry Stakeholders Contacted**

<b>Manufacturer and Supplier</b>	Coinstar
	Crane Payment Innovations
	Jarden Zinc
<b>Logistics</b>	American Bankers Association
	National Armored Car Association
<b>Commerce</b>	American Amusement Machine Association
	Coin Laundry Association
	International Association of Amusement Parks and Attractions
	International Parking Institute
	Los Angeles County Metropolitan Transportation Authority
	National Automatic Merchandising Association (vending)

Source: GAO | GAO-16-177

While information from our industry stakeholders is not generalizable, the diverse perspectives of the stakeholders gave us a better understanding of the impacts to industry costs should a change in coin composition occur. We then contacted these selected stakeholders to understand the data sources, methodology, and assumptions used to develop their cost estimates. We asked these stakeholders to identify the coin denominations that are of importance to them, the type of coin acceptance machines that are used in their industries, and the circumstances that would require software and/ or hardware changes that that would need to occur to accept new coins. Finally, we asked these stakeholders to comment on potential changes to business practices that we developed. These changes were designed to reduce the conversion costs to industry. We did not, nor did the U.S. Mint, validate any industry cost estimates. Finally, we interviewed officials from the Royal Canadian Mint and the Royal Mint of the United Kingdom about their experiences in transitioning to steel-based coins.

To identify how potential coin composition options could affect government savings and industry costs, we reviewed the legal framework in Coin Modernization, Oversight, and Continuity Act of 2010 and the cost estimates prepared by the U.S. Mint, Navigant, and industry associations.

We also interviewed industry representatives, who generally called for no changes to the quarter (and in one case, no changes to coins at all). From this work, we independently identified some options for changing coin composition. This list of options is not exhaustive. For each option we identified, we described how each option could affect government savings and industry costs.

We conducted this performance audit from March 2015 to December 2015, in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.



# Appendix II: Summary Assessment of the U.S. Mint's Cost-Estimating Process Compared to Best Practices

We developed the *GAO Cost Estimating and Assessment Guide* in order to establish a consistent methodology that is based on best practices and that can be used across the federal government for developing, managing, and evaluating program cost estimates.<sup>1</sup> We have identified 12 steps that, followed correctly, should result in reliable and valid cost estimates that management can use for making informed decisions. We assessed the U.S. Mint's cost estimation process using the 12 steps associated with high-quality, reliable cost estimates. Table 5 provides a summary assessment on our comparison of the estimate to best practices.

**Table 5: Summary Assessment of U.S. Mint Cost-Estimating Process Compared to Best Practices**

Steps	GAO's assessment	Rationale for assessment
1. Define estimates purpose	Partially met	U.S. Mint officials stated that the purpose of the cost estimate was established in Pub. L. No. 111-302. However, while U.S. Mint officials stated that the scope of the cost estimate was defined in the 2012 biennial report as a fixed point in time, GAO found that the report and its appendixes did not establish one point in time for the estimate's scope.
2. Develop the estimating plan	Partially met	The team that developed the cost estimate was from a centralized office and worked closely with technical personnel to develop the estimate. While the personnel tasked with the development of the cost estimate were not certified as cost estimators, their background was from related fields (i.e. accounting and budget analysts). Additionally, there was no formal plan to develop the cost estimate.
3. Define the program's characteristics	Partially met	The 2014 biennial report to Congress provides a detailed appendix (appendix 4) that includes technical details and descriptions regarding the different coin compositions and assumptions for the change to production. However, the report does not include documentation regarding assumptions for an acquisition strategy or program parameters necessary to develop an estimate and there is no formal sign-off of the assumptions in the appendix prior to the development of the coin composition estimate.
4. Determine the estimating structure	Partially met	The U.S. Mint uses a standard Work Breakdown Structure (WBS) that is supposed to identify the cost and technical data needed to develop estimates for changes to each coin composition variation. However, the elements are not defined within the cost estimate.
5. Identify ground rules and assumptions	Minimally met	U.S. Mint officials stated that the estimate represented constant labor and building maintenance costs; however, these assumptions were not documented in the 2014 biennial report. Furthermore, key assumptions such as a currency transition schedule and inflation were not included.

<sup>1</sup>GAO, *GAO Cost Estimating and Assessment Guide: Best Practices for Developing and Managing Capital Program Costs*, [GAO-09-3SP](#) (Washington, D.C.: Mar. 2, 2009).

**Appendix II: Summary Assessment of the U.S. Mint's Cost-Estimating Process Compared to Best Practices**

<b>Steps</b>	<b>GAO's assessment</b>	<b>Rationale for assessment</b>
6. Obtain the data	Partially met	The estimating model includes the underlying source data and labelled that data regarding the source, content, and units. However, the estimate does not include analysis of cost drivers nor does it normalize the costs for inflation prior to comparing 2014 data to 2013 data.
7. Develop the point estimate and compare to an independent cost estimate	Partially met	The U.S. Mint has had the data reviewed by internal and external organizations and the technical tests of the various alternate coin compositions reviewed by an external organization. Additionally, subsequent files provided by the U.S. Mint document the factors used to determine the cost for each alternative metal composition and provides supplier quotes as part of the estimate's back-up. However, the estimate does not use cross checks to ensure consistency in the point estimate's results and it did not compare its estimate to an independent cost estimate to see if the results were similar.
8. Conduct a sensitivity analysis	Minimally met	While U.S. Mint officials stated that they discussed sensitivity analysis as part of their meetings regarding coin composition, there was no formal documented sensitivity analysis associated with the estimate.
9. Conduct a risk analysis	Not met	No cost risk/uncertainty analysis was included as part of the estimate.
10. Document the estimate	Minimally met	While the documentation of the 2014 biennial report to Congress includes an executive summary and table that shows the different prices associated with each alternate coin composition, the documentation does not follow best practices to include a description of the estimating method and data used to develop each cost element.
11. Present estimate to management	Fully met	U.S. Mint officials stated that the cost estimate was briefed to their management as part of their review process and provided documentation showing management's approval.
12. Update the estimate	Partially met	The U.S. Mint updates their cost estimate for all alternative metal compositions every two years for the biennial report. However, the U.S. Mint does not compare or report on any variance or differences between estimates.

Fully met—U.S. Mint provided complete evidence that satisfies the elements of the best practice.

Substantially met—U.S. Mint provided evidence that satisfies a large portion of the elements of the best practice.

Partially met—U.S. Mint provided evidence that satisfies about half of the elements of the best practice.

Minimally met—U.S. Mint provided evidence that satisfies a small portion of the elements of the best practice.

Not met—U.S. Mint provided no evidence that satisfies any of the elements of the best practice.

Source: GAO analysis of agency documentation and GAO Best Practices. | GAO-16-177

# Appendix III: Comments from the Department of the Treasury




DEPUTY DIRECTOR

DEPARTMENT OF THE TREASURY  
UNITED STATES MINT  
WASHINGTON, D.C. 20220

MEMORANDUM FOR JOHN SHUMANN  
ASSISTANT DIRECTOR  
UNITED STATES GOVERNMENT ACCOUNTING OFFICE

**THROUGH:** Rosie Rios  
Treasurer of the United States

**FROM:** Rhett Jeppson   
Principal Deputy Director  
United States Mint

**SUBJECT:** United States Mint's Comments on GAO's Draft Report entitled, *U.S. Coins: Implications of Changing Metal Compositions*

The United States Mint (Mint) appreciates the opportunity to review GAO's draft report, *U.S. Coins: Implications of Changing Metal Compositions*. In response, the Mint provides the following comments.

**Cost Assessment:**

The GAO Cost Estimating and Assessment Guide provides best practices for estimating costs for capital projects (direct link to OMB A-11). The guide is not directed for use on non-capital, operational changes. There is no OMB circular, law, or regulation that requires agencies to use the guide for operational changes such as coinage composition. The guide's preface states, "We developed the Cost Guide in order to establish a consistent methodology that is based on best practices and that can be used across the federal government for developing, managing, and evaluating **capital program** cost estimates." (Emphasis added.) Manufacturing coinage is an operational process directly covered under Statement of Federal Financial Accounting Standard 4 (SFFAS 4) and specifically relates to:

- *Purposes Of Using Cost Information*
  - 31. *There are many different purposes for which cost information may be used by the federal government. The focus of this statement is on cost information needed to improve federal financial management and managerial decision making.*
  - 32. *In managing federal government programs, cost information is essential in the following five areas: (1) budgeting and cost control, (2) performance measurement, (3) determining reimbursements and setting fees and prices, (4) program evaluations, and (5) making economic choice decisions. SFFAS 4 (emphasis added).*

The report does not discuss Concurrent Technologies Corporation's (CTC) cost estimates; this is a gap that should be addressed. The work CTC performed in the 2012 report can be characterized as an independent assessment and its cost estimates would add value and balance to the report.

The report includes a statement (page 10) that "Without following best practices, the U.S. Mint's estimates may not be reliable." The Mint takes exception to this statement.

**Other Comments:**

In the draft GAO report executive summary, entitled *What GAO Found*, GAO states in part in the third and final paragraph:

*The Coin Modernization, Oversight, and Continuity Act of 2010 requires that any new coins work in existing machines that accept coins "to the greatest extent practicable." U.S. Mint officials have not yet analyzed whether the options they are considering meet these criteria for making recommendations to Congress. U.S. Mint officials said when and if Treasury makes recommendations to Congress, they will ensure that recommendations are within the framework of the Act.*

The draft report ends with the following on page 21:

*As previously discussed, the Act requires that any new coins work without interrupting existing coin acceptance equipment "to the greatest extent practicable." In addition, it required that any recommendations to change coin composition may not have "significant" changes to coin acceptance machines. The U.S. Mint has not yet determined how to quantify "significant" change and "to the greatest extent practicable" to determine what, if any, recommendations could be made to change the composition of coins that would be authorized under the Act. The Act does not set a timeframe for providing recommendations to Congress and the U.S. Mint has not established a timeframe for making any recommendations. However, U.S. Mint officials told us that, if and when the Department of the Treasury makes any recommendations to Congress, the U.S. Mint and Treasury officials will ensure that the recommendations are within the framework of the Act.*

To clarify, the Mint has analyzed the Act in its entirety, including the statutory provisions that require special considerations for the vending industry regarding any recommendations for new metal coin compositions. Indeed, these provisions have played a key role in shaping our research and development efforts to date. The GAO draft report on page nine recognizes that the Act's language on minimizing the effect on vending machines and commercial coin processing equipment led the U.S. Mint to pursue research on a seamless alternative as well as a co-circulating alternative.

Because the technology used by the vending industry is constantly evolving, it will be important for the U.S. Mint to provide a current analysis of these statutory factors at such time as the bureau is ready to recommend new coinage materials to Congress. What may have been considered a "significant" coin change to the vending industry in the past may not necessarily be as important in the future. Likewise, a recommendation to change only one denomination, such

as the nickel, will likely have a different effect on the vending industry than implementing changes to the nickel, dime, and quarter at the same time.

The report implies that the Mint “recently” excluded the quarter due to counterfeit concerns. This issue was addressed in the Mint’s 2014 Biennial Report. We suggest the narrative be adjusted to reflect that.

Table 2 shows the Mint’s projected cost savings, but it only generally describes the industry’s cost impact. Earlier in the report, GAO developed and spoke to a range. We suggest the table reflect that so that a more valid comparison can be made.

Executive Summary – GAO Highlights – a suggested clarification would be to add... “**Since 2006**” metal prices have risen to where the total production unit costs of a penny and nickel exceed their face value.

Page 4 – First sentence states that the Federal Reserve determines the number of coins required to meet the public needs. This should be changed to the Secretary of the Treasury.

Page 4 – Last sentence. We suggest GAO add that economic activity and the number of cash transactions also impact coin production.

Page 16 – Second paragraph. GAO should mention how many machines were converted in England as compared to the United States.

If you have any other questions and/or would like to discuss further, please contact Dave Motl, the Mint’s Chief Financial Officer, at 202 354-8304.

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# Appendix IV: GAO Contact and Staff Acknowledgments

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## GAO Contact

Lori Rectanus, (202) 512-2834 or [rectanusl@gao.gov](mailto:rectanusl@gao.gov)

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## Staff Acknowledgments

In addition to the contact name above, John W. Shumann (Assistant Director), Aisha Cabrer, Tim Guinane, Dave Hooper, Jennifer Leotta, Steve Martinez, Josh Ormond, Amy Rosewarne, and Elizabeth Wood made key contributions to this report.

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# Appendix V: Accessible Data

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## Agency Comment Letter

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Text of Appendix III:  
Comments from the  
Department of the Treasury

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Page 1

DEPARTMENT OF THE TREASURY

UNITED STATES MINT

WASHINGTON, D.C. 20220

DEPUTY DIRECTOR

MEMORANDUM FOR JOHN SHUMANN

ASSISTANT DIRECTOR

UNITED STATES GOVERNMENT ACCOUNTING OFFICE

THROUGH:

Rosie Rios

Treasurer of the United States

FROM:

Rhett Jeppson

Principal Deputy Director

United States Mint

SUBJECT:

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