2016 Biennial Report to the Congress

as required by

The Coin Modernization, Oversight, and Continuity Act of 2010 (Public Law 111-302)

United States Mint

Department of the Treasury

June 2017

Background

The Coin Modernization, Oversight, and Continuity Act of 2010, Public Law 111-302 (Act) authorizes the Secretary of the Treasury (Secretary) to conduct research and development (R&D) on alternative metallic materials for all circulating coins with the goal of reducing production costs. The Act also requires the Secretary to provide a biennial report to Congress on the status of coin production costs, cost trends for such production, and possible new metallic material or technologies for the production of circulating coinage.

The United States Mint (Mint), a bureau of the Department of the Treasury, submitted its first biennial report in December 2012 and a second biennial report in December 2014. This report is the third biennial report as required by the Act.

Summary

The Mint manufactures new circulating coins, which supplement Federal Reserve Bank (FRB) coin inventories, to meet the needs of commerce through the Nation's banking system. Typically, the Mint's annual production of new circulating coins is the net difference between total demand for circulating coins and total deposits received by the FRB from the banking system. The FRB buys new coins from the Mint at face value. The difference between the face value and the Mint's manufacturing cost is known as seigniorage. The Mint transfers seigniorage to the Treasury General Fund to help reduce the national debt.

Production Cost Comparison

FY 2016 unit costs are less than those reported in our 2014 Biennial report. The unit costs for FY 2016 are pennies (1.5 cents), nickels (6.3 cents), dimes (3.1 cents), and quarters (7.6 cents). The unit cost for both pennies and nickels remained above face value for the eleventh consecutive fiscal year. In addition, Federal Reserve orders for new coin increased in both the 2015 and 2016 fiscal years. FY 2015 circulating coin shipments to the FRB increased by 3.2 billion units (23.9 percent) to a total 16.2 billion coins compared to FY 2014 and FY 2016 circulating coin shipments to the FRB of 16.3 billion units increased by 100 million units (1 percent) over the FY 2015.

UNIT COST OF PRODUCING AND DISTRIBUTING COINS BY DENOMINATION

2016	One-Cent	Five-Cent	Dime	Quarter-Dollar	$1 Coin
Cost of Goods Sold	$0.0131	$0.0551	$0.0269	$0.0672	$0.0000
Selling, General & Administrative	$0.0017	$0.0071	$0.0034	$0.0080	$0.0000
Distribution to FRB	$0.0002	$0.0010	$0.0005	$0.0011	$0.0000
Total Unit cost	$0.0150	$0.0632	$0.0308	$0.0763	$0.0000

2015	One-Cent	Five-Cent	Dime	Quarter-Dollar	$1 Coin
Cost of Goods Sold	$0.0125	$0.0664	$0.0315	$0.0755	$0.0000
Selling, General & Administrative	$0.0015	$0.0068	$0.0033	$0.0076	$0.0000
Distribution to FRB	$0.0003	$0.0012	$0.0006	$0.0013	$0.0000
Total Unit cost	$0.0143	$0.0744	$0.0354	$0.0844	$0.0000

2014	One-Cent	Five-Cent	Dime	Quarter-Dollar	$1 Coin
Cost of Goods Sold	$0.0143	$0.0699	$0.0338	$0.0775	$0.0000
Selling, General & Administrative	$0.0021	$0.0102	$0.0049	$0.0109	$0.0000
Distribution to FRB	$0.0002	$0.0008	$0.0004	$0.0011	$0.0000
Total Unit cost	$0.0166	$0.0809	$0.0391	$0.0895	$0.0000

R&D Alternative Metals

Since the 2014 Biennial Report, the Mint focused on evaluating the following materials:

	Material	Composition	Tested On
1	80/20 Cupronickel (80/20)	Copper, nickel, and manganese	5-cent Dime Quarter-dollar*
2	C99750T-M	Copper, nickel, manganese, and zinc	5-cent
3	C77000Y-O	Copper, nickel, and zinc	5-cent
4	R52 Stainless Steel	Iron, nickel, chromium, and carbon	5-cent
5	Nickel-plated CPZ	Nickel plated on copper-plated zinc	5-cent

* This material was tested as cladding on the dime and quarter-dollar, with intent of applying results to the half-dollar.

The first material (80/20) in the above chart was tested extensively internally and externally with coin authentication manufacturers representing approximately 80 percent of the coin authentication machine market. The Mint identified the 80/20 material as potentially seamless because, although the 80/20 material worked in the coin authentication machines tested, many other industry segments – laundry, coin wrapping, parking, and settlement systems-- use proprietary technology that were not included in the Mint's testing. Should a new alternative material be required, the Mint would need to engage all coin stakeholders to test the material prior to circulating coins manufactured with the new alternative material. The 80/20 material is applicable to 5-cent, dime, and quarter production. Material savings of approximately 1 percent ($4.3 million annually) are associated with a change to the 80/20 material, based on FY 2016 production volumes. These savings are a projection at an instant in time and are sensitive to changes in volume and metal prices so should only be considered rough potential savings and not budgetary projections.

The C99750T-M is another potentially seamless material for the 5-cent piece, having the same electromagnetic signature (EMS), dimensions, and piece weight as the current material. The C99750T-M is also a potentially suitable replacement for the cladding material of the dime, quarter-dollar, and half-dollar coins, but extensive testing of the C99750-M as a cladding material is required before making a determination. C99750T-M utilizes both manganese and zinc to offset more expensive nickel while maintaining the same electromagnetic signature. Potential annual material savings based on FY16 production volumes would be approximately $9.7M for the 5-cent and an additional $8.8M for the clad 10-cent and 25-cent.   The C77000Y-O offers less material savings than C99750T-M, so the Mint suspended more extensive evaluation of it in early 2016.The last two alternatives listed in the table above are co-circulate alternatives, meaning they do not have the same EMS or piece weight as that of the current material. Co-circulate materials offer greater materials savings, but would require modifications to coin-accepting and -handling equipment at a cost that exceeds the benefit of the savings.

R52 stainless steel is an austenitic steel with outstanding wear and corrosion resistances. It would be appropriate only for the 5-cent coin because of fraud concerns associated with the abundance of austenitic stainless steel commonly available in other products. The Mint determined that R52 is viable for coining, but observed issues in production (notably, a mottled, “orange peel” appearance around the edge due to strain hardening) that made coins of this material less aesthetically acceptable than current U.S. coins. Functionally, the mottled appearance does not impact its use as a coin; rather it is an aesthetic consideration that could create objections in the coin collecting hobby. This concern combined with a shorter die life, renders the coinability-rating of the R52 material less viable than the current material. R52 is projected to have an annual material cost savings of approximately $18M. Nickel Plated CPZ was tested and not found to be feasible for US coinage.

Again, these savings are a projection at an instant in time and are sensitive to changes in volume and metal prices so should only be considered rough potential savings and not budgetary projections.

The Mint has been working to develop two other co-circulate alternatives for consideration. One is a monolithic alternative for application to the 5-cent and the other is a plated construction suitable for application to the 5-cent and 10-cent.

R&D Changes to Coin Production

During Phase III, the Mint identified an optimized system for the 5-cent coining process that can increase die life through subtle changes to the design and geometry that do not negatively impact the already approved design. These changes are ready for full-scale production trials (i.e. no longer R&D). Once fully developed, this new system will enable coining presses to use less pressure and still obtain optimal detail in the coins produced. An estimate of projected savings for the optimized system is contingent on additional testing that allows the Mint to determine the effect on die life.

The coin striking process is a whole system, no part of which can be changed without impacting another. The aspects include not only die shape and necessary pressure, but also level of detail, sharpness of transitions, and relief height in the coin’s design; overall curvature of the coins’ faces; and the upsetting process, which preforms the blank’s material to the planchet’s rim.

The hardness characteristic of the metal being struck is a key factor in minting. Greater hardness increases the coins’ wear resistance, but the striking tonnage must be increased to get the same level of detail in harder coins as in softer ones. This greater striking pressure would reduce the die life and increase the stamping process cost. To keep the same tonnage for striking those new materials and still achieve the same image detail, the Mint studied both die and blank upset geometry. By matching the die and upset curves, the necessary pressure around the coins’ edge was reduced, and normal pressure distribution became uniform. After the modification, the new harder material can be stamped to get the same image detail with the same tonnage as current production.

The Mint has also finished research on a potential production technology, called "pushback blanking," which cuts blanks from externally annealed coils of material versus the current process of cutting the blanks from the coil first and then annealing the blanks internally at the Mint.[1] While the Mint found pushback blanking to be technically feasible, it could not verify savings; additional testing will be conducted on a full size pilot die to establish high volume production capability and refine the estimates for internal vs. external annealing of the strip.

The Mint saw promising results when the modified upset/design system was used on the current material, alternative materials, and also with pushback-blanked material. Beyond that, the optimization process also shows promise with other circulating denominations, whether alternative materials or current materials are used.

Conclusions

a) Seamless Materials

1. After testing with key coin authentication manufacturers, 80/20 is considered a potentially seamless alternative for producing 5-cent (monolithic), 10-cent, and 25-cent (when bonded to a copper core) circulating coins, which matches the current key characteristics (EMS, color, and piece weight) of circulating coins, but only provides incremental savings in material (approximately 1 percent). In addition, during the testing of the 80/20 material the Mint qualified potential strip suppliers and validated Mint production processes.

2. Two other potentially seamless alternatives were tested; the C77000Y-O (utilizes zinc as a lower cost substitute for nickel) and the C99750T-M (uses both zinc and manganese as lower cost substitutes for nickel) were tested at the Variability Lot stage for application on the monolithic 5-cent. Work was halted on the C77000Y-O because the C99750T-M represents the greatest potential for material savings while remaining seamless on the key coin characteristics of color, EMS, and piece weight.

   Although the C99750T-M is capable of being bonded to a copper core, the Mint has not yet conducted testing on the application of the C99750T-M on the dime or quarter-dollar. The extensive experience gained over the past six years provides the Mint with confidence that this alloy is potentially seamless; however, larger scale testing is recommended before making any changes to existing coin material.

[1] Annealing is a heat process whereby a metal is heated to a specific temperature and then allowed to cool slowly. This softens the metal which means it can be cut and shaped more easily.

b) Co-Circulate Materials

1. R52 Stainless was found to be a technically viable co-circulate alternative for the 5-cent coin. Larger-scale testing was not deemed necessary, but if the material were to be approved for use in the 5-cent coin, there would need to be a two- to three-year transition period to develop internal practices to handle the higher hardness of the material (similar to those for nickel-plated and multi-ply-plated steels) and blank preparation/lubrication. This would also coincide with a similar period for coin acceptors and handlers to make the necessary changes to their installed base of coin acceptors and sorters.

2. A more recent development version of plated zinc, Nickel-Plated Copper-Plated Zinc (NPCPZ), was tested to determine its feasibility. Although it exhibits a different EMS than plated steels and is easier to coin, wear testing of NPCPZ indicated a failure because of severe edge deformation, which led to a breakdown of the edge plating, exposing the zinc core. NPCPZ was determined not to be a feasible co-circulate alternative.

c) Production Improvement

1. The Mint determined Pushback Blanking to be technically feasible, but at this point there does not appear to be a cost advantage to external annealing with Pushback Blanking compared to internal annealing with conventional blanking. Because coin blanks—whether made conventionally or with pushback blanking—would need to be washed, dried, and upset, there is not an appreciable impact either to required production floor space or to staffing. The process does provide an alternative to be considered in the future when planning for the capital replacement of the Mint's ten annealing lines.

2. Structured trials were completed with optimized die designs and various rimming profiles on the 5-cent coin. The results show promise and can yield incremental efficiencies in the production of circulating coin and other Mint products. The Mint will continue validating these results and next steps include small-scale coining trials to optimize 5-cent design and rim profile followed by production-scale die life testing. Objective data gathered during these coining trials will be used to develop a Finite Element Analysis (FEA) model to reduce the need for as many trials and enable the application of the optimization to other Mint products.