

APPENDIX 17A. REGULATORY IMPACT ANALYSIS SUPPORTING MATERIAL

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APPENDIX 17A. REGULATORY IMPACT ANALYSIS SUPPORTING MATERIAL

17A.1 BACKGROUND ON MARKET PENETRATION CURVES DEVELOPED BY XENERGY

Xenergy, Inc. developed a re-parameterized, mixed-source information diffusion model to estimate market impacts induced by financial incentives for energy-efficient appliances. The basic premise of this mixed-source model is that information diffusion drives technology adoption.

There is extensive economic literature on the diffusion process of new products as technologies evolve. Some of the literature focuses primarily on the development of analytical models of diffusion patterns of new products for individual consumers or for technologies from competing firms.^{1,2,3} One study records researchers' attempts to investigate underlying factors that drive diffusion processes.⁴ Because of the distinct characteristics of diverse new products, few studies have conclusively developed a universally-applicable model. Some key findings, however, have seemed to gain wide recognition in academia and industry.

First, new technologies may not be adopted by all potential users, regardless of their economic benefits and technological merits. Therefore, a ceiling on the adoption rate exists for many products. Second, not all adopters purchase new products at the same time; some act earlier after the introduction of a new product, while others respond slowly, waiting for products to become more mature. Third, diffusion processes can be approximately characterized by asymmetric S-curves, depicting three stages of diffusion: starting, accelerating, and decreasing as the adoption ceiling is being reached.

An important diffusion model, the epidemic model, is widely used in marketing and social studies on diffusion. It assumes that a) consumers value the benefits of a new product identically and b) the cost of a new product is constant or declines monotonically over time. What induces a consumer to purchase the new product is information about the availability and the benefits of the product. In other words, it is information diffusion that drives new product adoption by individual consumers.³ The model incorporates information diffusion from both internal sources (news spread by word of mouth from early adopters) and external sources (the "announcement effect" by government, other institutions, or commercial advertising) by superimposing a logistic function with an exponential function.^{1,4}

The relative degree of influence by internal or external sources determines the general shape of the diffusion curve of a specific product.^{1,4} For instance, if the adoption of one particular product is more influenced by external sources of information diffusion (announcement effect) than by internal sources (word of mouth among earlier adopters to prospective adopters), the rate of diffusion at the beginning stage of the diffusion process is much higher. This reflects the immediate information exposure to a significant number of

prospective adopters brought about by external sources, in contrast to the more gradual exposure to internal sources such as news propagation by earlier adopters, a small proportion of the population, to other prospective adopters. Graphically speaking, a relatively dominant external source of information diffusion gives an immediate jump-start to the adoption of a new product in the first years, forming a concave curve with respect to the Y axis (see the exponential curve in Figure A.1). Adoption of a new product with a stronger influence by internal sources of information diffusion (such as a socially-tightened network formed by prospective adopters) may start with a few early adopters and gradually increase as the number of adopters grows, and thus form a convex curve (see the logistic curve in Figure 17A.1.1).

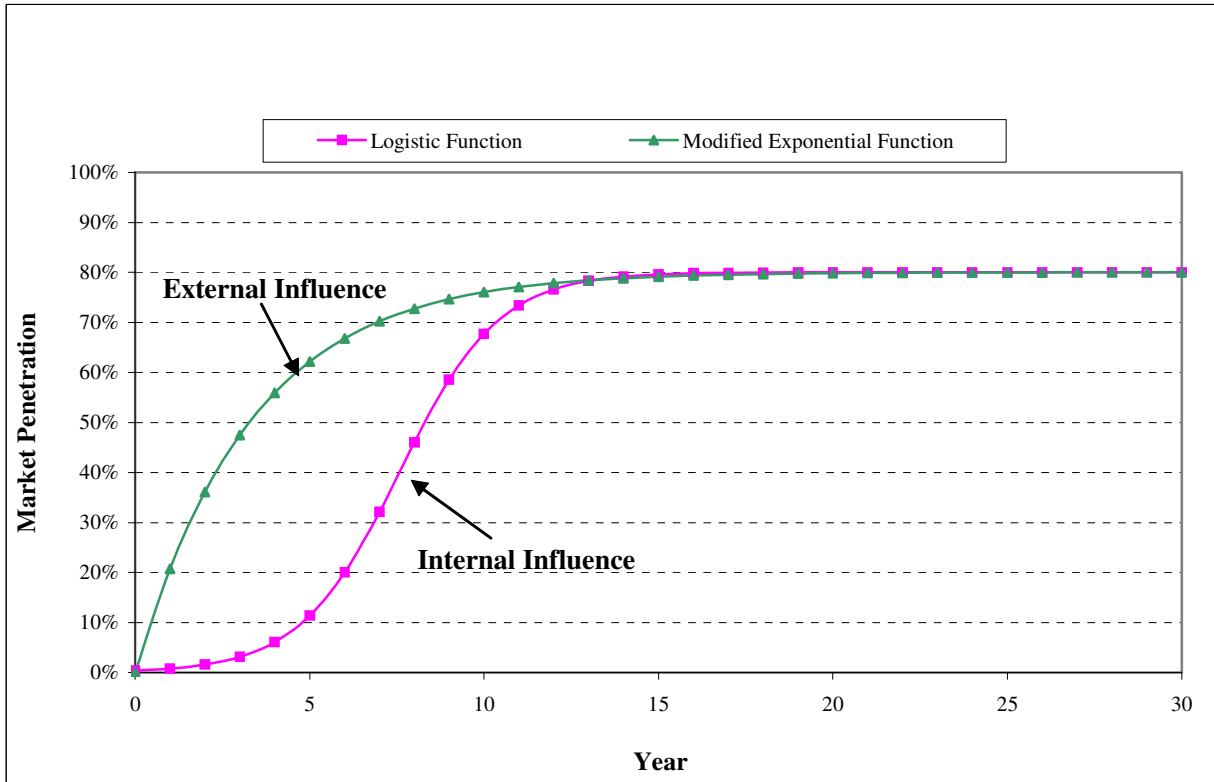


Figure 17A.1.1 Comparison of Exponential and Logistic Curves Showing External and Internal Influences on Consumers

17A.2 UTILITY REBATE PROGRAMS FOR COMMERCIAL CLOTHES WASHERS AND RESIDENTIAL DISHWASHERS

The following two tables present a summary of rebate program amounts offered throughout the U.S. for commercial clothes washers and for residential dishwashers. Since there have not been rebate programs for conventional cooking products or microwave ovens, DOE studied rebate programs for residential dishwashers as an analogous product.

17A.2.1 Rebate Programs for Commercial Clothes Washers

DOE found 24 agencies with programs for commercial clothes washers. Rebates for this product have been offered by electric utilities, gas utilities, water utilities, and municipal and regional agencies. These entities offer rebates for commercial clothes washers meeting efficiency criteria that usually match those set by ENERGY STAR or the Consortium for Energy Efficiency. In some areas customers can receive rebates from both their energy and water utilities. Table 17A.2.1 shows the agency names, States, rebate amounts, and program websites. Multiple entries in the table indicate either that an agency offers two rebate amounts (i.e., one for customers with gas water heaters and another for those with electric water heaters) or that the agency is an umbrella for several rebate programs. The average rebate amount is a simple average of the wide range of all of the entries (rather than being population-weighted).

Table 17A.2.1 Rebate Programs for Commercial Clothes Washers

Utility or Agency	State	Amount	Website
Alliant Energy	IA	\$100	http://alliantenergy.com/docs/groups/public/documents/pub/p015218.hcsp
CPUC LightWash (former)	CA	\$450	http://www.cuwcc.org/Uploads/annual_reports/FY2003/Annual_Report_2003.pdf
LADWP	CA	\$430	http://www.ladwp.com/ladwp/cms/ladwp001820.jsp
SoCalGas, SCE	CA	\$210	http://www.mwdsaveabuck.com/multifamily.html
SDG&E (Sempra)	CA	\$75	http://sdge.com/residential/PY2006-08MFApplication.pdf
BAWSCA (Bay Area)	CA	\$220	https://www.conservationrebates.com/programs/cop/CoinOp.aspx
Contra Costa County Water District/PG&E	CA	\$220	http://www.ccwater.com/conserves/rebates_cwasher.asp
SFPUC	CA	\$150	http://www.friendlyplumber.com/plumbing101/commercialwasherrebate.html
		\$200	
EBMUD	CA	\$150	http://www.ebmud.com/conserving_&_recycling/non_residential/clotheswasher_rebate/default.htm
		\$250	
Silicon Valley Power	CA	\$350	http://www.siliconvalleypower.com/bus/?sub=rebatewash
City of Austin	TX	\$250	http://www.ci.austin.tx.us/watercon/cwasher.htm
		\$100	
Seattle Public Utilities	WA	\$100	http://www.savingwater.org/business_laundryrebate.htm
		\$125	
		\$50	http://www.savingwater.org/inside_laundry_washwise.htm
		\$75	
		\$100	
BPA		\$180	http://www.bpa.gov/Energy/N/projects/post2006conservation/manual/
		\$75	
PG&E	CA	\$35	http://www.pge.com/includes/docs/pdfs/application/07App_GI.pdf
		\$75	
EBMUD	CA	\$150	http://www.ebmud.com/conserving_&_recycling/non_residential/clotheswasher_rebate/default.htm
		\$250	
Riverside Public Utilities	CA	\$75	http://www.riversideca.gov/utilities/busi-energystar.asp
Albuquerque Water Utility Authority	NM	\$100	http://www.abcwua.org/pdfs/Washer%20Rebate.pdf
Marin County	CA	\$50	www.marinwater.org
Helix Water District (San Diego)	CA	\$300	
Truckee Donner PUD	CA	\$100	http://www.tdpud.org/index.php?cId=34
Energy Trust of Oregon	OR	\$225	http://www.energytrust.org/residential/mf/clotheswashers.html
		\$180	
Puget Sound Energy	WA	\$200	http://www.pse.com/solutions/forbusiness/pages/comRebates.aspx?tab=4&chapter=2
Seattle Water Utility	WA	\$300	http://www.savingwater.org/business_WSTP.htm#financial
Number of Agencies	24		
Average Rebate Amount		\$174	
Rebate Percent of Incremental Cost		31%	

Websites last accessed January, 2008.

17A.2.2 Rebate Programs for Residential Dishwashers

DOE found 88 agencies with programs for residential dishwashers. Rebates for this product have been offered by electric utilities, gas utilities, and municipal and regional agencies. These entities offer rebates for dishwashers meeting efficiency criteria that usually match those set by ENERGY STAR or the Consortium for Energy Efficiency. Table 17A.2.2 shows the agency names, States, rebate amounts, and program websites. Multiple entries in the table indicate that an agency offers two rebate amounts, one for customers with gas water heaters and another for those with electric water heaters. The average rebate amount is a simple average of the wide range of all of the entries.

Table 17A.2.2 Rebate Programs for Residential Dishwashers

Utility or Agency	State	Amount	Website
City of Roseville	CA	\$25	http://www.conservationrebates.com/programs/REC/AppliancesProgram.aspx
Aspen CORE	CO	\$75	http://www.aspencore.org/sitepages/pid46.php#washer
Fort Collins Utilities	CO	\$25	http://fcgov.com/water/washer-rebate.php
Holy Cross Energy	CO	\$25	http://www.holycross.com/
		\$75	
Longmont Power	CO	\$50	http://www.ci.longmont.co.us/lpc/index.htm
Groton Utilities	CT	\$60	http://www.grotonutilities.com/elec_conserv_resident_appliance.asp
Kootenai Electric	ID	\$25	http://www.kec.com/rebates.php
Rocky Mountain Power	ID, UT	\$20	http://www.homeenergysavings.net/idaho/dishwashers.html
Linn County REC	IA	\$50	http://www.linncountyrec.com/cgi-script/csarticles/articles/000003/000334.htm
Maquoketa Valley REC	IA	\$25	http://www.mvec.com/index.php?option=com_content&task=view&id=20&Itemid=23#star
Eastern Iowa REC	IA	\$25	http://www.easterniowa.com/
East-Central REC	IA	\$25	http://www.ecirec.coop/prod_serv/rebates.shtml
TIP REC	IA	\$35	http://www.tiprec.com/rebates.html
Consumers Energy	IA	\$25	http://www.consumersenergy.coop/residential/products_services/incentives/index.html
Guthrie County REC	IA	\$25	http://www.guthrie-rec.coop/cgi-script/csArticles/articles/000000/000049.htm
Farmers REC	IA	\$25	http://www.farmersrec.com/Promotions.htm
Southwest Iowa REC	IA	\$25	http://www.swiarec.coop/prod_serv/rebates.shtml
Clarke EC	IA	\$25	http://www.cecnet.net/rebates.html
Chicopee Electric Light	MA	\$50	http://www.celd.com/news.php?id=36
Concord Muni Light Plant	MA	\$50	http://www.concordma.gov/pages/ConcordMA_LightPlant/appliance
Mansfield Muni Elec Dep't	MA	\$75	http://www.mansfieldelectric.com/rebateBrochure/billingForm.html
Marblehead Light Dep't	MA	\$25	http://www.marbleheadelectric.com/rebate.htm
Marblehead Light Dep't	MA	\$50	http://www.marbleheadelectric.com/rebate.htm
North Attleboro Electric	MA	\$30	http://www.dsireusa.org/library/includes/incentivesearch.cfm?Incentive_Code=MA61F&Search=TableType&type=Rebate&CurrentPageID=7&EE=1&RE=1
Reading Muni Light Dep't	MA	\$50	http://www.rmld.com/rebates.htm
Shrewsbury Electric	MA	\$50	http://www.shrewsbury-ma.gov/light/rebates.asp
Wakefield Gas & Light	MA	\$50	http://www.wakefield.ma.us/Public_Documents/WakefieldMA_MGLD/rcsprogram.htm
Lincoln Electric Co-Op	MT	\$10	http://www.lincolnelectric.coop/energy_star_rebates.htm
City of Anaheim	CA	\$50	http://www.anaheim.net/article.asp?id=992
Burbank Water and Power	CA	\$75	http://www.burbankwaterandpower.com/homerewards.html
PG&E	CA	\$30	http://www.pge.com/res/rebates/dishwashers/index.html
		\$50	
SDG&E (Sempra)	CA	\$30	http://www.sdge.com/residential/singleFamilyRebate/docs/rebateOverview.pdf
Southern California Gas	CA	\$30	http://www.socalgas.com/residential/savemoney/instant.shtml
City of Lompoc	CA	\$50	http://www.cityoflomdoc.com/splash/utilprograms.htm
Glendale Water and Power	CA	\$40	http://www.glendalewaterandpower.com/smart_home_saving_rebates.asp

Utility or Agency	State	Amount	Website
Hercules Municipal Utility	CA	\$50	http://www.dsireusa.org/library/includes/incentivesearch.cfm?Incentive_Code=CA133F&Search=TableType&type=Rebate&CurrentPageID=7&EE=1&RE=1
IID Energy	CA	\$50	http://www.dsireusa.org/library/includes/incentivesearch.cfm?Incentive_Code=CA97F&Search=TableType&type=Rebate&CurrentPageID=7&EE=1&RE=1
Lassen MUD	CA	\$35	http://www.lmud.org/rebate.htm
Lodi Electric Utility	CA	\$25	http://www.lodielectric.com/residential/rebateoffer.php?id=2
City of Palo Alto	CA	\$50	http://www.cityofpaloalto.org/depts/utl/news/details.asp?NewsID=65&TargetID=12
Plumas Sierra Rural Electric Coop	CA	\$35	http://www.psln.com/energy_rebates.php?sec=enersol&pag=enerreb
Redding Electric Utility	CA	\$25	http://www.reupower.com/energysvc/energy-rebates.asp
Riverside Public Utilities	CA	\$50	http://www.riversideca.gov/utilities/resi-energystar.asp
SMUD	CA	\$30	http://www.smud.org/rebates/index.html
		\$50	
Truckee Donner PUD	CA	\$100	http://www.tdpud.org/index.php?cId=34
City of Gridley	CA	\$25	http://www.gridley.ca.us/documents/appliancerebateapp.pdf
Imperial Irrigation Districtq	CA	\$50	http://www.iid.com/Media/PubRebApp-En_WEB07b.pdf
Hawaiian Electric Company	HI	\$50	http://www.heco.com/portal/site/heco/menuitem.508576f78baa14340b4c0610c510b1ca/?vgnextoid=a2670c0ed85b2110VgnVCM1000005c011bacRCRD&vgnnextchannel=6558f2b154da9010VgnVCM10000053011bacRCRD&vgnnextfmt=default&vgnnextrefresh=1&level=0&ct=article#mainContent%20id
Kauai Island Utility Cooperative	HI	\$50	http://www.kiuc.coop/co-opportunities/index.htm
Blachly Lane, Eugene	OR	\$5	http://www.northwestenergystar.com/index.php?cID=183&searchType=state&state=OR&type%5B%5D=Dishwashers&slSearch=search
Central Electric, Redmond	OR	\$25	
Ashland	OR	\$30	
	OR	\$60	
Bandon	OR	\$50	
Columbia River PUD, St. Helens	OR	\$25	
Consumers Power, Philomath	OR	\$20	
Douglas EC, Roseburg	OR	\$30	
Emerald, Eugene	OR	\$25	
Eugene Water and Electric	OR	\$20	
Forest Grove	OR	\$30	
Milton Freewater	OR	\$15	
Monmouth	OR	\$15	
Salem Electric	OR	\$60	
Tillamook	OR	\$25	
Wasco, The Dalles	OR	\$25	
Cheney	WA	\$21	
		\$24	
Chewelah	WA	\$100	

Utility or Agency	State	Amount	Website
Mason County PUD #3, Shelton	WA	\$25	
Mason County PUD #1, Shelton	WA	\$60	
Modern Electric, Spokane	WA	\$22	
		\$24	
Snohomish County, Everett	WA	\$35	
Okanogan County	WA	\$50	
Coulee Dam	WA	\$60	
Wahkiakum PUD #1, Cathlamet	WA	\$75	
Delco	ID	\$15	
City of Rupert	ID	\$15	
East End, Rupert	ID	\$15	
Riverside Electric, Rupert	ID	\$50	
Soda Springs	ID	\$15	
Fall River, Ashton	ID	\$25	
Farmers, Heyburn	ID	\$15	
Idaho Falls	ID	\$15	
Northern Lights, Sagle	ID	\$25	
Glacier, Cut Bank	MT	\$25	
Lincoln, Eureka	MT	\$10	
Mission Valley , Pablo	MT	\$50	
Anoka Muni Utility	MN	\$50	http://www.ci.anoka.mn.us/vertical/Sites/%7B213A9A90-C8E1-49AA-AC02-51D3C4882D33%7D/uploads/%7B93715A51-EA59-4213-BD5E-73A264F5E4F2%7D.PDF
Buffalo Municipal Utilities	NY	\$50	http://www.ci.buffalo.mn.us/Utilities/Electric/EnergyRebate.htm
BPA		\$25	http://www.bpa.gov/Energy/N/projects/post2006conservation/manual/
Number of Agencies	88		
Average Rebate Amount		\$37	

Websites last accessed January, 2008.

17A.3 DEVELOPMENT OF CONSUMER TAX CREDITS IMPACT ANALYSIS

Clothes Washers

To analyze the Consumer Tax Credits policy for commercial clothes washers (CCWs), DOE studied the Oregon Department of Energy's experience with Residential Energy Tax Credits (RETC) for residential clothes washers (RCWs). DOE chose RCWs because the product is similar to CCWs, and because the available data on Oregon's Business Energy Tax Credits (BETC)—which include CCWs—did not disaggregate tax credits claimed by appliance. Also, the ENERGY STAR program did not have data on CCW shipments.

Note that the RETC efficiency level for RCWs is minimum MEF of 2.0 and maximum water factor of 6.5. The proposed standard level for CCWs is minimum MEF of 2.2 and maximum water factor of 5.1, which is a stricter level. However, DOE assumed that by 2012 consumer behavior would be similar under a tax credit program aimed at high-efficiency CCW units.

As stated in the RIA chapter, DOE calculated that Oregon taxpayers claimed credits for almost one quarter of Oregon's total residential clothes washer shipments in 2006. DOE needed to estimate what portion of those taxpayers claiming credits were primarily motivated by the tax credits themselves, what portion were influenced by utility rebate incentives, and what portion were "free riders"—those who would have purchased efficient appliances without a tax credit or rebate incentive but still claimed the tax credit. To attribute the Oregon tax credits claimed to each of these influences, DOE reviewed a report prepared by KEMA on efficient RCWs in the Northwest. This report studied the penetration of residential clothes washers in Oregon and Washington, two neighboring states that have utility rebate programs for this product.⁵ KEMA made a "highly conservative estimate" that 50 percent of Oregon's ENERGY STAR clothes washers were "ultra high efficiency" (UHE)^a units, based on tax credit data from Oregon Department of Energy (ODOE). In contrast, KEMA made a "highly conservative estimate" that 15 percent of Washington's ENERGY STAR clothes washers were UHE models, based on rebate data from two utilities in the State. (KEMA also estimated that 19% of the State's population was eligible for rebates.) KEMA's report attributed the difference in UHE market share in the two States to the Oregon tax credits. Based on this attribution, DOE estimated that 38 percent of the tax credits claimed were actually due to rebates; these represent 9 percent of total shipments.

To estimate the free riders among the Oregon clothes washer shipments, DOE used the market penetration of the baseline CCW units on the penetration curve presented in Figure 17.3.6. This penetration was 9.2 percent of total shipments, which is 38 percent of the number of tax credit claims. DOE then estimated that the remaining 24 percent of the Oregon clothes

^a Units meeting specifications of minimum MEF of 2.20 and maximum WF of 6.5 (which are also the Oregon tax credit specifications).

washer tax credits claimed for the years 1998–2005 were attributable to tax credits alone, or 5.8 percent of total shipments.

Dishwashers

Because there have not been consumer tax credits for conventional cooking products and microwave ovens, DOE analyzed Oregon's RETC data for dishwashers as an analogous kitchen product. For 2006 DOE calculated that Oregon taxpayers claimed credits for 14 percent of Oregon's total dishwasher shipments. DOE did not find data comparing Oregon and Washington's efficient dishwasher sales. To estimate the portions of these tax credit claims that were likely due to utility rebates and to market impacts, DOE reviewed a report by Itron on utility rebate programs in California. That report compared the percentage of free riders in residential clothes washer and dishwasher rebate programs in 2005.⁶ Itron found that the penetration rate of ENERGY STAR dishwashers (85%) was much higher than that of ENERGY STAR clothes washers (40%).^b Itron also found that the percentage of free riders was greater for dishwasher programs than for clothes washer programs. DOE's previous estimates showed that the incremental cost from the baseline was much smaller for high-efficiency dishwashers than for high-efficiency clothes washers,^{7,8} which could explain the higher penetration rate for efficient dishwashers; an incentive program for a product whose market share is already high would tend to have more free riders. Similarly, conventional cooking product models meeting the target level have a high market share and a small incremental cost for those units not needing electric outlets, indicating that dishwashers are an appropriate analogous product. Based on these various factors, DOE estimated that market impacts (part of which are due to free riders) were responsible for a higher percentage of dishwasher tax credit claims than were market impacts for residential clothes washer tax credit claims.

Itron's report contained two estimates of free riders for ENERGY STAR dishwashers for 2005. DOE took the simple average of the supplier estimate of 93% in the self-reported consumer estimate of 59%, yielding 76%. DOE compared this to the simple average of free rider estimates for residential clothes washers, which were 77% from suppliers and 43% from consumers, yielding 60%. DOE assumed that the difference in free riders between the two products would be on the order of the difference between these two estimates (16%).

DOE interpreted the higher percentage of consumers purchasing dishwashers as free riders and then claiming tax credits, and the lower percentage of taxpayers influenced primarily by rebates, estimating that 49 percent of Oregon's 2006 dishwasher tax credits claimed (6.9 percent of total dishwasher shipments) were due to market impacts. It estimated that utility rebates were responsible for 32 percent of tax credits claimed (4.5 percent of total shipments). DOE attributed the remaining 20 percent of tax credits claimed (2.8 percent of total shipments) to tax credits.

^b Values are from ENERGY STAR website based on D&R International data by state.

17A.4 EPACT 2005 FEDERAL TAX CREDIT LEVELS FOR RESIDENTIAL APPLIANCES AND APPLIANCE MANUFACTURERS

17A.4.3 Residential Appliances

The residential appliance Federal tax credit qualification specifications are:

- Furnaces and boilers: Annual Fuel Use Efficiency (AFUE) 95 or higher
- Central air conditioning units: highest tier standards set by the Consortium for Energy Efficiency (CEE), which require a SEER of 15 and an EER of 12.5 for split systems and SEER 14 and EER 12 for single-package systems.
 - Air-source heat pumps must have a HSPF of 9 or greater, SEER 15 or higher, and EER 13 or higher.
 - Ground-source heat pumps must meet the following criteria (the same criteria as for ENERGY STAR):
 - Closed-loop systems—14.1 cooling EER and 3.3 COP
 - Open-loop systems—16.2 EER and 3.6 COP
 - Direct-expansion systems—15 EER and 3.5 COP. In addition, ground-source heat pumps must include a desuperheater (which preheats water for a water heater) or an integrated water heating system.
- Fans for heating and cooling systems: fan uses no more than 2 percent of total heating system energy use, as defined by DOE test procedure.
- Water heaters:
 - Gas or propane water heaters—Energy Factor of at least 0.8. The only models that meet this standard currently are tankless water heaters and some systems that combine both space and water heating.
 - Heat pump water heaters—Energy Factor of at least 2.0

17A.4.4 Energy Efficient Appliance Credits for Manufacturers

Each manufacturer is limited to a total of \$75 million for all credits under this provision. Of that cap, no more than \$20 million can be claimed for the lowest tier of qualifying refrigerators. The tax credit amounts and criteria for production of energy-efficient appliances are as follows:

- Clothes washers: \$100 for models that meet the 2007 ENERGY STAR[®] criteria
- Refrigerators (three tiers):
 - \$75 for models that save at least 15 percent relative to 2001 Federal standards (same as the current ENERGY STAR criteria); available only in 2006
 - \$125 for models that save at least 20 percent relative to 2001 Federal standards
 - \$175 for models that save 25 percent or more relative to 2001 Federal standards
- Dishwashers: \$32.31 for models that meet the 2007 ENERGY STAR criteria

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- ⁶ Itron And KEMA. 2004/2005 Statewide Residential Retrofit Single-Family Energy Efficiency Rebate Evaluation. 2007. Prepared for The California Public Utilities Commission, Pacific Gas and Electric Company, San Diego Gas and Electric Company, Southern California Edison, and Southern California Gas Company. Itron, Inc. and KEMA, Inc.: Oakland, CA. CPUC-Id#: 1115-04.
- ⁷ U.S. Department of Energy. *Technical Support Document: Energy Efficiency Standards for Consumer Products and Commercial and Industrial Equipment: Residential Dishwashers, Dehumidifiers, and Cooking Products, and Commercial Clothes Washers*, November 2007. Washington, DC. Chapter 8.
<http://www.eere.energy.gov/buildings/appliance_standards/residential/home_appl_tsd.html>
- ⁸ U.S. Department of Energy. *Final Rule Technical Support Document (TSD): Energy Efficiency Standards for Consumer Products: Clothes Washers*, December 2000. Washington, DC. Chapter 7.
<http://www.eere.energy.gov/buildings/appliance_standards/residential/clwash_0900_r.html>