



Health Insurance Exchange Public Use Files (Exchange PUFs) General Information

This document outlines important information about the Health Insurance Exchange Public Use Files (Exchange PUFs), including data source, file size, variables, key assumptions, analytic utility, and support information. A data dictionary is also available for each of the separate Exchange PUF files.

1. Overview of the PUFs

The Centers for Medicare & Medicaid Services (CMS) Center for Consumer Information & Insurance Oversight (CCIIO) publishes the Exchange PUFs in order to improve transparency and increase access to data on Qualified Health Plans (QHPs) and Stand-alone Dental Plans (SADPs) offered through the Exchanges in the individual and Small Business Health Options Program (SHOP) markets. The Exchange PUFs include data from Federally-facilitated Exchanges (FFE)¹ including states performing plan management functions², and State-based Exchanges that rely on the federal information technology platform for QHP eligibility and enrollment (SBE-FPs).³

The Exchange PUFs exclude data from SBEs that do not rely on the federal platform for QHP eligibility and enrollment.⁴ For data on SBE states, see the [State Based Health Insurance Exchange Public Use Files \(SBE PUFs\)](#).

The PUFs are available for plan years 2014 through 2023 to support timely research and analysis of Health Insurance Exchange data. The 2023 Exchange PUFs will be updated regularly to reflect the plan data that consumers will see when shopping for a QHP or SADP. The 2023 Exchange PUFs include data on certified plans of Friday Health Plans of Georgia (HIOS Issuer ID 90617), Friday Health Plans of North Carolina (HIOS Issuer ID 77320), and Friday Health Plans of Oklahoma (HIOS Issuer ID 91538), which are not accepting new consumer enrollment.

Twelve separate files comprise the Exchange PUFs: (1) Benefits and Cost Sharing PUF (BenCS-PUF), (2) Plan Attributes PUF (Plan-PUF), (3) Rate PUF (Rate-PUF), (4) Business Rules PUF (BR-PUF), (5) Service Area PUF (SA-PUF), (6) Network PUF (Ntwrk-PUF), (7) Plan ID Crosswalk PUF (CW-PUF), (8) Machine-readable URL PUF (MR-PUF), (9) Transparency in Coverage PUF (TC-PUF), (10) Quality PUF (Qual-PUF), (11) Nationwide Quality Rating System PUF (NatQRS-PUF) and (11) Enrollee Survey PUF (ES-PUF).

CCIIO manages the generation and release of the Exchange PUF datasets, with the following specific exceptions: Quality PUF, Nationwide Quality Rating System PUF, and Enrollee Survey PUF. These three

¹ FFE states in PY2023 are Alabama, Alaska, Arizona, Florida, Georgia, Indiana, Louisiana, Mississippi, Missouri, North Carolina, North Dakota, Oklahoma, South Carolina, Tennessee, Texas, Wisconsin, and Wyoming.

² FFE states performing plan management functions in PY2023 are Delaware, Hawaii (individual market), Illinois, Iowa, Kansas, Michigan, Montana, Nebraska, New Hampshire, Ohio, South Dakota, Utah, and West Virginia.

³ SBE-FP states in PY2023 are Arkansas (individual market), Oregon (individual market), and Virginia.

⁴ SBE states in PY2023 are Arkansas (SHOP market), California, Colorado, Connecticut, District of Columbia, Hawaii (SHOP market), Idaho, Kentucky, Maine, Maryland, Massachusetts, Minnesota, Nevada, New Jersey, New Mexico, New York, Oregon (SHOP market), Pennsylvania, Rhode Island, Vermont, and Washington.

PUF datasets are managed by the CMS Center for Clinical Standards and Quality (CCSQ). Note that the Nationwide Quality Rating System PUF and Enrollee Survey PUF are the only two Exchange PUFs that report data on SBE issuers.

2. Data Source of the PUFs

The Exchange PUFs contain data submitted by health insurance issuers during the QHP/SADP certification process. In accordance with 45 C.F.R. part 155 subpart K, CMS reviews QHP/SADP applications from issuers that are applying to offer on-exchange QHPs and SADPs in FFE states including states performing plan management functions. SBE-FP states review QHP/SADP applications from issuers that are applying to offer on-exchange QHPs and SADPs in their states. The QHP/SADP application collects both issuer-level information and plan-level benefit and rate data, largely through standardized data templates.

Issuers in FFE states submit standardized QHP/SADP templates to CMS through the Health Insurance Oversight System (HIOS). Issuers in FFE states performing plan management functions or SBE-FP states submit standardized data templates through the System for Electronic Rate and Form Filing (SERFF). Issuers participating in the Multi-State Plan (MSP) Program submit templates through the U.S. Office of Personnel Management’s (OPM) online application portal. CMS aggregates data from the three submission systems (HIOS, SERFF, and OPM) to create the Exchange PUFs.

Issuers submit data to CMS separately from the QHP/SADP application for the following Exchange PUFs: Machine-readable URL PUF, Quality PUF, Nationwide Quality Rating System PUF, and Enrollee Survey PUF.

3. Description of the PUFs

An overview of the content, format, and size of each of the files that comprise the Exchange PUFs is outlined in the tables below.

Table 3.1: File Format Descriptions for 2023 Exchange PUFs

File Name	Type*	File Size**	Description
2023 Benefits and Cost Sharing PUF (BenCS-PUF)	CSV	621 MB	Plan variant-level data on essential health benefits, coverage limits, and cost sharing.
2023 Plan Attributes PUF (Plan-PUF)	CSV	45 MB	Plan variant-level data on maximum out of pocket payments, deductibles, health savings account (HSA) eligibility, and other plan attributes.
2023 Rate PUF (Rate-PUF)	CSV	420 MB	Plan-level data on rates based on an eligible subscriber’s age, tobacco use, and geographic location, and family-tier rates.
2023 Business Rules PUF (BR-PUF)	CSV	1.9 MB	Plan-level data on rating business rules, such as maximum age for a dependent and allowed dependent relationships.
2023 Service Area PUF (SA-PUF)	CSV	1.6 MB	Issuer-level data on geographic service areas including state, county, and ZIP code.
2023 Network PUF (Ntwrk-PUF)	CSV	0.1 MB	Issuer-level data identifying provider network URLs.

File Name	Type*	File Size**	Description
2023 Plan ID Crosswalk PUF (CW-PUF)	CSV	18 MB	Plan-level data that maps plans offered in 2022 to plans offered in 2023.
2023 Machine-readable URL PUF (MR-PUF)	Excel	26 KB	Issuer-level URL locations for machine-readable plan network provider and formulary information.
2023 Transparency in Coverage PUF (TC-PUF)	Excel	1.05 MB	Issuer-level claims, appeals, and active URL data. This PUF contains data from PY2021 for issuers participating in the Exchange in PY2023.
2023 Quality PUF (Qual-PUF)	Excel	487 KB	Quality ratings data for plans offered through the Federally Facilitated Exchange. The data are posted at the CMS Quality Rating System website.
2023 Nationwide Quality Rating System PUF (NatQRS-PUF)	Excel	240 KB	Quality ratings data for plans offered through Exchanges nationwide, including State Based Exchanges (SBEs). The data are posted at the CMS Quality Rating System website.
2023 Enrollee Survey PUF (ES-PUF)	CSV	439 KB	Results from the QHP Enrollee Survey for plans offered through Exchanges nationwide, including State Based Exchanges (SBEs). The data are posted at the CMS Quality Rating System website.

*Comma separated values (CSV)

**Note: Approximate file size

Table 3.2: File Format Descriptions for 2022 Exchange PUFs

File Name	Type*	File Size**	Description
2022 Benefits and Cost Sharing PUF (BenCS-PUF)	CSV	521 MB	Plan variant-level data on essential health benefits, coverage limits, and cost sharing.
2022 Plan Attributes PUF (Plan-PUF)	CSV	37 MB	Plan variant-level data on maximum out of pocket payments, deductibles, health savings account (HSA) eligibility, and other plan attributes.
2022 Rate PUF (Rate-PUF)	CSV	378 MB	Plan-level data on rates based on an eligible subscriber's age, tobacco use, and geographic location; and family-tier rates.
2022 Business Rules PUF (BR-PUF)	CSV	1.7 MB	Plan-level data on rating business rules, such as maximum age for a dependent and allowed dependent relationships.
2022 Service Area PUF (SA-PUF)	CSV	1.6 MB	Issuer-level data on geographic service areas including state, county, and ZIP code.
2022 Network PUF (Ntwrk-PUF)	CSV	0.1 MB	Issuer-level data identifying provider network URLs.
2022 Plan ID Crosswalk PUF (CW-PUF)	CSV	13 MB	Plan-level data that maps plans offered in 2021 to plans offered in 2022.

File Name	Type*	File Size**	Description
2022 Machine-readable URL PUF (MR-PUF)	Excel	25 KB	Issuer-level URL locations for machine-readable network provider and formulary information.
2022 Transparency in Coverage PUF (TC-PUF)	Excel	844 KB	Issuer and plan-level claims, appeals, and active URL data. This PUF contains data from PY2020 for issuers participating in the Exchange in PY2022.
2022 Quality PUF (Qual-PUF)	Excel	443 KB	Quality ratings data for plans offered through the Federally-Facilitated Exchange. The data are posted at the CMS Quality Rating System website.
2022 Nationwide Quality Rating System PUF (NatQRS-PUF)	Excel	118 KB	Quality ratings data for plans offered through Exchanges nationwide, including State Based Exchanges (SBEs). The data are posted at the CMS Quality Rating System website.
2022 Enrollee Survey PUF (Qual-PUF)	CSV	352 KB	Results from the QHP Enrollee Survey for plans offered through Exchanges nationwide, including State Based Exchanges (SBEs). The data are posted at the CMS Quality Rating System website.

*Comma separated values (CSV)

**Note: Approximate file size

Table 3.3: File Format Descriptions for 2021 Exchange PUFs

File Name	Type*	File Size**	Description
2021 Benefits and Cost Sharing PUF (BenCS-PUF)	CSV	374 MB	Plan variant-level data on essential health benefits, coverage limits, and cost sharing.
2021 Plan Attributes PUF (Plan-PUF)	CSV	29 MB	Plan variant-level data on maximum out of pocket payments, deductibles, health savings account (HSA) eligibility, and other plan attributes.
2021 Rate PUF (Rate-PUF)	CSV	320 MB	Plan-level data on rates based on an eligible subscriber's age, tobacco use, and geographic location; and family-tier rates.
2021 Business Rules PUF (BR-PUF)	CSV	1.3 MB	Plan-level data on rating business rules, such as maximum age for a dependent and allowed dependent relationships.
2021 Service Area PUF (SA-PUF)	CSV	1.4 MB	Issuer-level data on geographic service areas including state, county, and ZIP code.
2021 Network PUF (Ntwrk-PUF)	CSV	0.1 MB	Issuer-level data identifying provider network URLs.
2021 Plan ID Crosswalk PUF (CW-PUF)	CSV	11 MB	Plan-level data that maps plans offered in 2020 to plans offered in 2021.
2021 Machine-readable URL PUF (MR-PUF)	Excel	23 KB	Issuer-level URL locations for machine-readable network provider and formulary information.

File Name	Type*	File Size**	Description
2021Transparency in Coverage PUF (TC-PUF)	Excel	640 KB	Issuer and plan-level claims, appeals, and active URL data. This PUF contains data from PY2019 for issuers participating in the Exchange in PY2021.
2021 Quality PUF(Qual-PUF)	Excel	170 KB	Quality ratings data for plans offered through the Federally-Facilitated Exchange. The data are posted at the CMS Quality Rating System website.
2021Nationwide Quality Rating System PUF (NatQRS-PUF)	Excel	121 KB	Quality ratings data for plans offered through Exchanges nationwide, including State Based Exchanges (SBEs). The data are posted at the CMS Quality Rating System website.

*Comma separated values (CSV)

**Note: Approximate file size

Table 3.4: File Format Descriptions for 2020 Exchange PUFs

File Name	Type*	File Size**	Description
2020 Benefits and Cost Sharing PUF (BenCS-PUF)	CSV	328 MB	Plan variant-level data on essential health benefits, coverage limits, and cost sharing.
2020 Plan Attributes PUF (Plan-PUF)	CSV	27 MB	Plan variant-level data on maximum out of pocket payments, deductibles, health savings account (HSA) eligibility, and other plan attributes.
2020 Rate PUF (Rate-PUF)	CSV	303 MB	Plan-level data on rates based on an eligible subscriber's age, tobacco use, and geographic location; and family-tier rates.
2020 Business Rules PUF (BR-PUF)	CSV	2 MB	Plan-level data on rating business rules, such as maximum age for a dependent and allowed dependent relationships.
2020 Service Area PUF (SA-PUF)	CSV	1 MB	Issuer-level data on geographic service areas including state, county, and ZIP code.
2020 Network PUF (Ntwrk-PUF)	CSV	0.1 MB	Issuer-level data identifying provider network URLs.
2020 Plan ID Crosswalk PUF (CW-PUF)	CSV	10 MB	Plan-level data that maps plans offered in 2019 to plans offered in 2020.
2020 Machine-readable URL PUF (MR-PUF)	Excel	22 KB	Issuer-level URL locations for machine-readable network provider and formulary information.
2020Transparency in Coverage PUF (TC-PUF)	Excel	806 KB	Issuer and plan-level claims, appeals, and active URL data. This PUF contains data from PY2018 for issuers participating in the Exchange in PY2020.
2020 Quality PUF(Qual-PUF)	Excel	155 KB	Quality ratings data for plans offered through the Federally-Facilitated Exchange. The data are posted at the CMS Quality Rating System website.

File Name	Type*	File Size**	Description
2020Nationwide Quality Rating System PUF (NatQRS-PUF)	Excel	121 KB	Quality ratings data for plans offered through Exchanges nationwide, including State Based Exchanges (SBEs). The data are posted at the CMS Quality Rating System website.

*Comma separated values (CSV)

**Note: Approximate file size

Table 3.5: File Format Descriptions for 2019 Exchange PUFs

File Name	Type*	File Size**	Description
2019 Benefits and Cost Sharing PUF (BenCS-PUF)	CSV	239 MB	Plan variant-level data on essential health benefits, coverage limits, and cost sharing.
2019 Plan Attributes PUF (Plan-PUF)	CSV	21 MB	Plan variant-level data on maximum out of pocket payments, deductibles, health savings account (HSA) eligibility, and other plan attributes.
2019 Rate PUF (Rate-PUF)	CSV	313 MB	Plan-level data on rates based on an eligible subscriber's age, tobacco use, and geographic location; and family-tier rates.
2019 Business Rules PUF (BR-PUF)	CSV	2 MB	Plan-level data on rating business rules, such as maximum age for a dependent and allowed dependent relationships.
2019 Service Area PUF (SA-PUF)	CSV	1 MB	Issuer-level data on geographic service areas including state, county, and ZIP code.
2019 Network PUF (Ntwrk-PUF)	CSV	0.1 MB	Issuer-level data identifying provider network URLs.
2019 Plan ID Crosswalk PUF (CW-PUF)	CSV	9 MB	Plan-level data that maps plans offered in 2018 to plans offered in 2019.
2019 Machine-readable URL PUF (MR-PUF)	Excel	28 KB	Issuer-level URL locations for machine-readable network provider and formulary information.
2019 Transparency in Coverage PUF (TC-PUF)	Excel	75 KB	Issuer and plan-level claims, appeals, and active URL data. This PUF contains data from PY2017 for issuers participating in the Exchange in PY2019.
2019 Quality PUF(Qual-PUF)	Excel	46 KB	Quality ratings data for plans offered through the Federally-Facilitated Exchange. The data are posted at the CMS Quality Rating System website.

*Comma separated values (CSV)

**Note: Approximate file size

Table 3.6: File Format Descriptions for 2018 Exchange PUFs

File Name	Type*	File Size**	Description
2018 Benefits and Cost Sharing PUF (BenCS-PUF)	CSV	236 MB	Plan variant-level data on essential health benefits, coverage limits, and cost sharing.
2018 Plan Attributes PUF (Plan-PUF)	CSV	20 MB	Plan variant-level data on maximum out of pocket payments, deductibles, health savings account (HSA) eligibility, and other plan attributes.
2018 Rate PUF (Rate-PUF)	CSV	362 MB	Plan-level data on rates based on an eligible subscriber's age, tobacco use, and geographic location; and family-tier rates.
2018 Business Rules PUF (BR-PUF)	CSV	2 MB	Plan-level data on rating business rules, such as maximum age for a dependent and allowed dependent relationships.
2018 Service Area PUF (SA-PUF)	CSV	1 MB	Issuer-level data on geographic service areas including state, county, and ZIP code.
2018 Network PUF (Ntwrk-PUF)	CSV	0.1 MB	Issuer-level data identifying provider network URLs.
2018 Plan ID Crosswalk PUF (CW-PUF)	CSV	11 MB	Plan-level data that maps plans offered in 2017 to plans offered in 2018.
2018 Machine-readable URL PUF (MR-PUF)	Excel	27 KB	Issuer-level URL locations for machine-readable network provider and formulary information.
2018 Transparency in Coverage PUF(TC-PUF)	Excel	174 KB	Issuer and plan-level claims, appeals, and active URL data. This PUF contains data from PY2016 for issuers participating in the Exchange in PY2018.
2018 Quality PUF(Qual-PUF)	Excel	25 KB	Quality ratings data for plans offered through the Federally-Facilitated Exchange. The data are posted at the CMS Quality Rating System website.

*Comma separated values (CSV)

**Note: Approximate file size

Table 3.7: File Format Descriptions for 2017 Exchange PUFs

File Name	Type*	File Size**	Description
2017 Benefits and Cost Sharing PUF (BenCS-PUF)	CSV	383 MB	Plan variant-level data on essential health benefits, coverage limits, and cost sharing.
2017 Plan Attributes PUF (Plan-PUF)	CSV	32 MB	Plan variant-level data on maximum out of pocket payments, deductibles, health savings account (HSA) eligibility, and other plan attributes.
2017 Rate PUF (Rate-PUF)	CSV	489 MB	Plan-level data on rates based on an eligible subscriber's age, tobacco use, and geographic location; and family-tier rates.

File Name	Type*	File Size**	Description
2017 Business Rules PUF (BR-PUF)	CSV	3 MB	Plan-level data on rating business rules, such as maximum age for a dependent and allowed dependent relationships.
2017 Service Area PUF (SA-PUF)	CSV	2 MB	Issuer-level data on geographic service areas including state, county, and ZIP code.
2017 Network PUF (Ntwrk-PUF)	CSV	0.1 MB	Issuer-level data identifying provider network URLs.
2017 Plan ID Crosswalk PUF (CW-PUF)	CSV	14 MB	Plan-level data that maps plans offered in 2016 to plans offered in 2017.
2017 Machine-readable URL PUF (MR-PUF)	Excel	14 MB	Issuer-level URL locations for machine-readable network provider and formulary information.
2017 Transparency in Coverage PUF(TC-PUF)	Excel	87 KB	Issuer and plan-level claims, appeals, and active URL data. This PUF contains data from PY2015 for issuers participating in the Exchange in PY2017.
2017 Quality PUF (Qual-PUF)	Excel	44 KB	Quality ratings data for plans offered through the Federally-Facilitated Exchange.

*Comma separated values (CSV)

**Note: Approximate file size

Table 3.8: File Format Descriptions for 2016 Exchange PUFs

File Name	Type*	File Size**	Description
2016 Benefits and Cost Sharing PUF (BenCS-PUF)	CSV	506 MB	Plan variant-level data on essential health benefits, coverage limits, and cost sharing.
2016 Plan Attributes PUF (Plan-PUF)	CSV	39 MB	Plan variant-level data on maximum out of pocket payments, deductibles, health savings account (HSA) eligibility, and other plan attributes.
2016 Rate PUF (Rate-PUF)	CSV	749 MB	Plan-level data on rates based on an eligible subscriber's age, tobacco use, and geographic location; and family-tier rates.
2016 Business Rules PUF (BR-PUF)	CSV	4 MB	Plan-level data on rating business rules, such as maximum age for a dependent and allowed dependent relationships.
2016 Service Area PUF (SA-PUF)	CSV	2 MB	Issuer-level data on geographic service areas including state, county, and ZIP code.
2016 Network PUF (Ntwrk-PUF)	CSV	0.2 MB	Issuer-level data identifying provider network URLs.
2016 Plan ID Crosswalk PUF (CW-PUF)	CSV	14 MB	Plan-level data that maps plans offered in 2015 to plans offered in 2016.

File Name	Type*	File Size**	Description
2016 Machine Readable URL PUF (MR-PUF)	Excel	30 KB	Issuer-level URL locations for machine-readable network provider and formulary information.

*Comma separated values (CSV)

**Note: Approximate file sizes.

Table 3.9: File Format Descriptions for 2015 Exchange PUFs

File Name	Type*	File Size**	Description
2015 Benefits and Cost Sharing PUF (BenCS-PUF)	CSV	598 MB	Plan variant-level data on essential health benefits, coverage limits, and cost sharing.
2015 Plan Attributes PUF (Plan-PUF)	CSV	32 MB	Plan variant-level data on maximum out of pocket payments, deductibles, health savings account (HSA) eligibility, and other plan attributes.
2015 Rate PUF (Rate-PUF)	CSV	842 MB	Plan-level data on rates based on an eligible subscriber's age, tobacco use, and geographic location; and family-tier rates.
2015 Business Rules PUF (BR-PUF)	CSV	4 MB	Plan-level data on rating business rules, such as maximum age for a dependent and allowed dependent relationships.
2015 Service Area PUF (SA-PUF)	CSV	2 MB	Issuer-level data on geographic service areas including state, county, and ZIP code.
2015 Network PUF (Ntwrk-PUF)	CSV	0.3 MB	Issuer-level data identifying provider network URLs.
2015 Plan ID Crosswalk PUF (CW-PUF)	CSV	14 MB	Plan-level data that maps plans offered in 2014 to plans offered in 2015.

*Comma separated values (CSV)

**Note: Approximate file sizes.

Table 3.10: File Format Descriptions for 2014 Exchange PUFs

File Name	Type*	File Size**	Description
2014 Benefits and Cost Sharing PUF (BenCS-PUF)	CSV	347 MB	Plan variant-level data on essential health benefits, coverage limits, and cost sharing.
2014 Plan Attributes PUF (Plan-PUF)	CSV	21 MB	Plan variant-level data on maximum out of pocket payments, deductibles, health savings account (HSA) eligibility, and other plan attributes.
2014 Rate PUF (Rate-PUF)	CSV	688 MB	Plan-level data on rates based on an eligible subscriber's age, tobacco use, and geographic location; and family-tier rates.

File Name	Type*	File Size**	Description
2014 Business Rules PUF (BR-PUF)	CSV	1 MB	Plan-level data on rating business rules, such as maximum age for a dependent and allowed dependent relationships.
2014 Service Area PUF (SA-PUF)	CSV	1 MB	Issuer-level data on geographic service areas including state, county, and ZIP code.
2014 Network PUF (Ntwrk-PUF)	CSV	0.2 MB	Issuer-level data identifying provider network URLs.

*Comma separated values (CSV)

**Note: Approximate file sizes.

4. Variables in the PUFs

Each file has a separate data dictionary that describes the construction, format, and values of each variable. Users are encouraged to review the data dictionary for each file prior to conducting analysis.

5. Methodology and Key Assumptions

The QHP/SADP application process ensures that plans meet specific QHP/SADP certification standards. To create the Exchange PUFs, CMS extracted and aggregated data from issuers' QHP/SADP applications including information on plan design, benefits, cost sharing, rates, and geographic coverage, as these areas represent the core elements of the QHP/SADP application. Data from plans that did not complete the certification process for display on HealthCare.gov or were withdrawn from the certification process are excluded from the Exchange PUFs.

Users should note that CMS certifies SADPs even if the issuer does not intend to offer them through HealthCare.gov; these plans are referred to as off-Exchange SADPs and are included in the Exchange PUFs. CMS does not certify medical plans that are only offered outside of HealthCare.gov.

Therefore, the Exchange PUFs do not include data from off-exchange only QHPs. For additional information on the QHP/SADP application, review, and certification processes in the FFEs including states performing plan management functions, please see the Letter to Issuers in the Federally-facilitated Exchanges that CMS releases before each plan year. The Letter to issuers for the 2023 plan year can be found at <https://www.cms.gov/CCIIO/Resources/Regulations-and-Guidance/Downloads/Final-2023-Letter-to-Issuers.pdf>. Users should review the Data Disclaimer-User Agreement for additional background on data accuracy, integrity, and privacy protection.

6. Further Information

The plan year 2023 Exchange PUFs will be updated regularly during the year to incorporate approved data corrections from issuers including Small Business Health Options Program (SHOP) quarterly rate updates. Note that data in the plan year 2023 Exchange PUFs may vary from the data shown on HealthCare.gov due to differences in dates between the display of approved issuer data changes and the release of updated Exchange PUFs.