

Exhibit 4

Memorandum

From: Ruth Greenwood, Senior Legal Counsel¹
To: House Select Committee on Redistricting and Senate Redistricting Committee
Date: August 24, 2017
Subject: **Comparison of Efficiency Gaps in the NCGA Proposed 2017 House and Senate Plans and the Covington Plaintiffs' Proposed House and Senate Plans**

I have analyzed the districts and the associated data for each of the 2017 North Carolina General Assembly House Redistricting Plan (hereafter "NCGA Proposed House Plan"),² the 2017 North Carolina General Assembly Senate Redistricting Plan (hereafter, "NCGA Proposed Senate Plan"), the Covington Plaintiffs' Proposed House Plan (hereafter "Covington Proposed House Plan") and the Covington Plaintiffs' Proposed Senate Plan (hereafter "Covington Proposed Senate Plan"), using the "stat pack" (composed of past statewide election results by district) that was made available on the North Carolina General Assembly website in 2016.³

I conclude that both the Covington Proposed House and Senate Plans will treat voters of both parties in a significantly more equal way than the NCGA Proposed House and Senate Plans, across a range of likely electoral outcomes. I reiterate from my memo dated August 22, 2017, that the NCGA Proposed House and Senate Plans will likely provide a large and durable advantage to Republican voters and candidates in the coming elections due to the large efficiency gaps likely to be exhibited. I find that the Covington Proposed House and Senate Plans will likely exhibit significantly smaller efficiency gaps, more consistent with a district plan that will fairly convert voters' preferences into state legislative seats.

The expected value of the NCGA Proposed House Plan's efficiency gap (EG) is -11.35% while the Covington Proposed Plan's expected EG is only -1.93%.⁴ The Covington Proposed House Plan's expected EG is therefore over 80% smaller than the NCGA's Proposed House Plan's EG. The explanation for the negative efficiency gap in the Covington Proposed House Plan is likely that 32.5% of the districts remain

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² If the Proposed House Plan is altered, I will update this memo and resubmit it to the Redistricting Committees.

³ Available at <http://www.ncleg.net/representation/Content/BaseData/BD2016.aspx>. I have used these data because the stat pack that was released on August 21, 2017 did not provide election results at the census block level and so cannot be used to compare the NCGA Proposed Plan to other district configurations. The main difference between the data is that the stat pack used in this memo includes only elections from 2008-2014, while the stat pack released on August 21, 2017 included 2016 election results.

⁴ By social science convention, negative numbers indicate Republican advantage and positive numbers indicate Democratic advantage.

identical to the previous plan. If all districts were altered, it is likely a plan could be produced that would have an efficiency gap close to zero.

The expected value of the NCGA Proposed Senate Plan's efficiency gap (EG) is -11.1% while the Covington Proposed Senate Plan's expected EG is only -4.3%.⁵ The Covington Proposed Senate Plan's expected EG is therefore over 60% smaller than the NCGA's Proposed Senate Plan's EG. The explanation for the negative efficiency gap in the Covington Proposed Senate Plan is likely that 28% of the districts remain identical to the previous plan because those districts were not invalidated or not affected by necessary changes to any district ruled unconstitutional. If all districts were altered, it is likely a plan could be produced that would have an efficiency gap close to zero.

This memo sets out a brief explanation of what the efficiency gap measures, a summary of the data gathered and methods used, and then presents the results of my analyses showing the large efficiency gaps that are predicted for the NCGA Proposed House and Senate Plans and the smaller efficiency gaps predicted for the Covington Proposed House and Senate Plans.

The Efficiency Gap

The efficiency gap (EG) is one of several tools that social scientists use to gauge partisan symmetry (or lack thereof) in districting plans. Partisan symmetry exists when a district map gives political parties an equal opportunity to translate votes for their candidates into legislative seats. It means that “the electoral system treat[s] similarly-situated parties equally.”⁷

The EG has already become an accepted method for measuring partisan gerrymandering. A three-judge federal court has allowed Plaintiffs to proceed in their challenge of North Carolina's 2016 Congressional Redistricting Plan on a theory of liability that is based on partisan symmetry generally, as measured by the EG.⁸ A three-judge federal court in Wisconsin has likewise determined that “the EG is corroborative evidence of” partisan gerrymandering for state legislative bodies.⁹ The EG provides strong evidence of whether a district map is biased toward one political party.

The EG assesses partisan asymmetry by focusing on the techniques that map-drawers use to create partisan gerrymanders. Gerrymanders are created by “packing” some of the opposing party's voters into overwhelmingly one-sided districts, and “cracking” the remaining opposing-party voters apart across other districts, so they are insufficiently numerous in each of those districts to elect their chosen candidates.¹⁰ Both of these methods create what social scientists refer to as “wasted” votes—votes that

⁵ By social science convention, negative numbers indicate Republican advantage and positive numbers indicate Democratic advantage.

⁷ *League of United Latin Am. Citizens v. Perry*, 548 U.S. 399, 466 (2006) (Stevens, J., concurring in part and dissenting in part) (citation omitted).

⁸ *Common Cause v. Rucho*, No. 1:16-CV-1026, 2017 WL 876307, at *3-4, *12 (M.D.N.C. Mar. 3, 2017).

⁹ *Whitford*, 218 F. Supp. 3d at 910.

¹⁰ See *Vieth v. Jubelirer*, 541 U.S. 267, 286 n.7 (2004) (plurality opinion).

were not necessary to the winning candidate's victory.¹¹ Any votes cast for a losing candidate, or cast for a winning candidate in excess of what's needed to prevail, are considered "wasted."¹² In a partisan gerrymander, the map-drawing party forces the opposing party to waste many more votes, making it more difficult for that party's supporters to translate votes into seats.¹³

EG analysis involves three steps. First, add up all of the votes each party wastes due to packing and cracking, across all of the races for a particular legislative body. Second, take the difference between the wasted votes cast for each major political party. Third, divide this difference by the total number of votes cast.¹⁴ The resulting percentage measures how much more effectively one party's voters are distributed compared to the other party's voters.

Expert analysis indicates that the value of an EG that suggests a partisan skew is likely to be large and durable for state legislative plans if it is greater in magnitude than +/-7%. Expert Report of Professor Simon Jackman at 5, *Whitford v. Gill*, 218 F.Supp.3d 837 (W.D. Wis. 2016), ECF No. 62.¹⁵

Data and Methods

The shapefiles and data used in this analysis were released in February, 2016 during the remapping process for the congressional district plan (following the order in *Harris v. McCrory*, 159 F. Supp. 3d 600).¹⁸ It includes data for the following races:

1. 2008 Attorney General
2. 2008 Auditor
3. 2008 Commissioner of Agriculture
4. 2008 Commissioner of Insurance
5. 2008 Commissioner of Labor
6. 2008 Governor
7. 2008 Lieutenant Governor
8. 2008 Superintendent of Public Instruction
9. 2008 U.S. Senate
10. 2010 U.S. Senate
11. 2012 Governor

¹¹ Nicholas O. Stephanopoulos & Eric M. McGhee, *Partisan Gerrymandering and the Efficiency Gap*, 82 U. Chi. L. Rev. 831, 849-50 (2015). Note that the word "wasted" is not meant as a pejorative: everyone's vote is meaningful. Rather, it is a technical term of art, developed by social scientists.

¹² See *Whitford v. Gill*, 218 F. Supp. 3d 837, 903-04 (W.D. Wis. 2016), *jur. postponed*, 137 S. Ct. 2268 (2017).

¹³ For instance, if Party A can win 60% of the seats with only 51% of the vote, but Party B would need 56% of the vote to win that same 60% of the seats, Party B is wasting many more votes than Party A.

¹⁴ In mathematical terms, the efficiency gap can be calculated as $(W_A - W_B) / n$, where W_A and W_B are the total number of wasted votes cast for Party A and Party B, respectively, and n is the total number of votes cast.

¹⁵ See also *Whitford*, 218 F. Supp. 3d at 905; Stephanopoulos & McGhee, *supra* note 11, at 888-89.

¹⁸ *Supra* note 1.

12. 2012 Lt. Governor
13. 2012 Auditor
14. 2012 Commissioner of Agriculture
15. 2012 Commissioner of Insurance
16. 2012 Commissioner of Labor
17. 2012 Secretary of State
18. 2012 Superintendent of Public Instruction
19. 2012 Treasurer
20. 2014 U.S. Senate

I used *Maptitude for Redistricting* to aggregate the votes for each of the districts in the NCGA Proposed House and Senate Plans and the Covington Proposed House and Senate Plans such that I had an average expected vote in each of the 120 and 50 districts respectively. I created this by adding the vote totals for the Democrats and dividing by twenty (the number of elections in the data set), and doing the same for the Republican votes.

I calculated the efficiency gap for the NCGA Proposed House and Senate Plans and the Covington Proposed House and Senate Plans at this expected value of the vote, by adding the wasted votes for the Democrats and Republicans, and dividing by the total number of votes. I then calculated the effects of swinging the vote by five percent in each direction (that is, up to five percent more favorable to Democrats, and up to five percent more favorable to Republicans), for a total swing of ten percentage points. I calculated the EG at one percent increments across this vote swing. This technique is called “sensitivity testing,” and is the standard method for predicting a plan’s performance over a range of electoral environments.

House Plans: Efficiency Gap Results

The NCGA Proposed House Plan has an extremely large EG across a range of vote shares. The expected value is -11.35% (that is, 11.35% in favor of Republican voters), but the total range of the EG for the ten percent swing in the vote goes from a high of -7.05% to a low of -12.84%.

By contrast, the Covington Proposed House Plan exhibits much lower EGs across the range of likely electoral outcomes. The expected value is -1.93% (that is 1.93% in favor of Republicans), and the total range of the EG for the ten percent swing in the vote goes from a high of -1.6% to a low of 3.38%.

The EG results from the swing analysis are shown in tabular and chart format below.

Projected vote	NCGA Proposed House Plan Efficiency Gap	Covington Proposed House Plan Efficiency Gap
Dem Vote-5%	-7.05%	-3.31%
Dem Vote -4%	-8.26%	-2.68%
Dem Vote -3%	-9.51%	-3.15%
Dem Vote -2%	-10.70%	-2.25%

Projected vote	NCGA Proposed House Plan Efficiency Gap	Covington Proposed House Plan Efficiency Gap
Dem Vote -1%	-11.04%	-3.38%
Expected EG (Statewide Dem vote share 51.4%)	-11.35%	-1.93%
Dem Vote +1%	-11.70%	-3.06%
Dem Vote +2%	-12.84%	-2.25%
Dem Vote +3%	-11.71%	-1.73%
Dem Vote +4%	-10.47%	-2.02%
Dem Vote +%5	-8.25%	-1.60%

Table 1: Efficiency Gap scores for NCGA Proposed House Plan and Covington Proposed House Plan, at Democratic vote shares from 46.4% to 56.4% (one percent intervals)

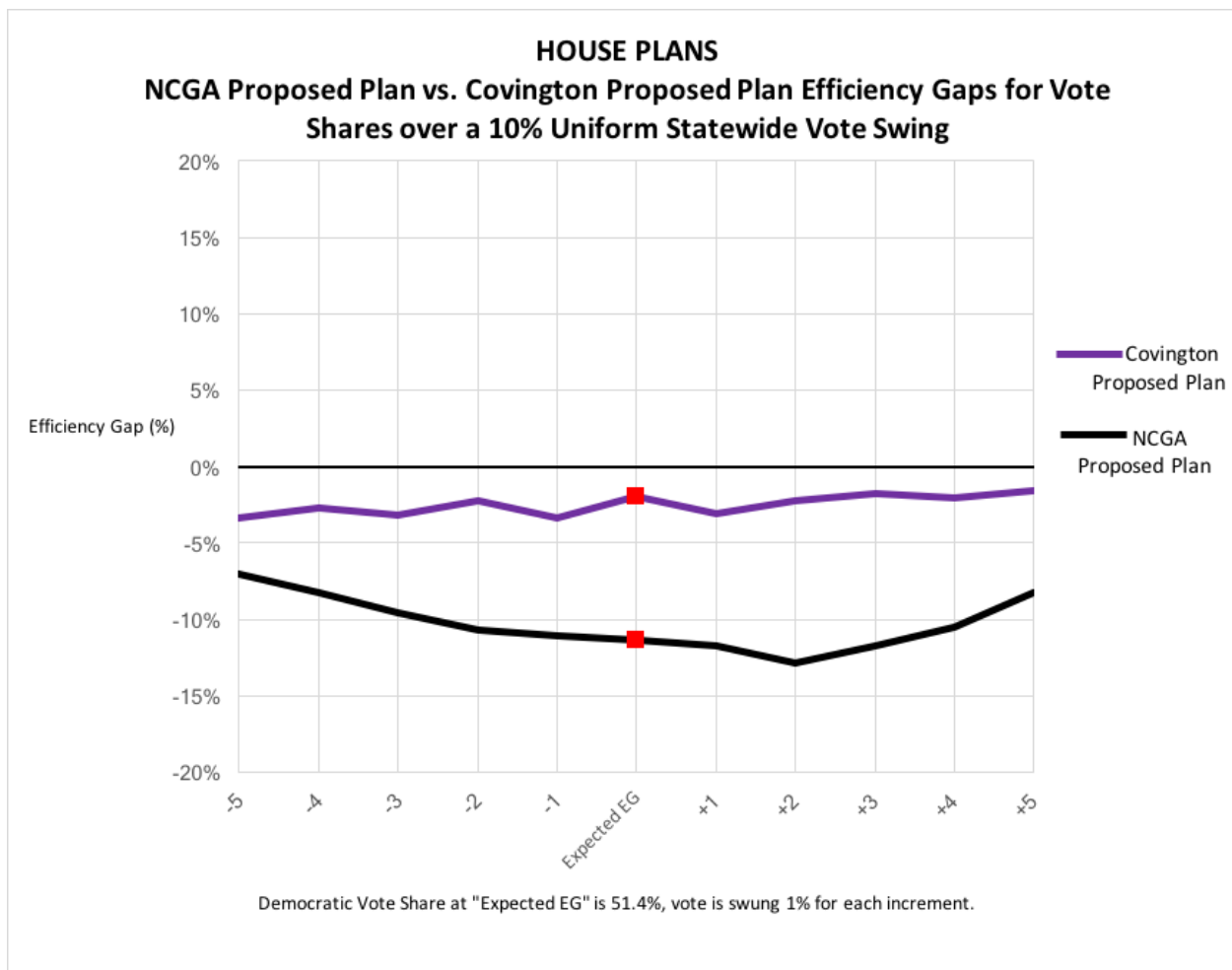


Figure 1: Efficiency Gap scores for NCGA Proposed House Plan vs. Covington Proposed House Plan at Democratic vote shares from 46.4% to 56.4% (one percent intervals)

Senate Plans: Efficiency Gap Results

The NCGA Proposed Senate Plan has an extremely large EG across a range of vote shares. The expected value is - 11.12% (that is, 11.12% in favor of Republican voters), but the total range of the EG for the ten percent swing in the vote goes from a high of -4.89% to a low of -13.49%.

By contrast, the Covington Proposed Senate Plan exhibits much lower EGs across the range of likely electoral outcomes. The expected value is -4.3% (that is 4.3% in favor of Republicans), and the total range of the EG for the ten percent swing in the vote goes from a high of 2.0% to a low of -6.2%.

The EG results from the swing analysis are shown in tabular and chart format below.

Projected vote	NCGA Proposed Senate Plan Efficiency Gap	Covington Proposed Senate Plan Efficiency Gap
Dem Vote -5%	-10.98%	-2.5%
Dem Vote -4%	-8.57%	-2.4%
Dem Vote -3%	-10.57%	-4.4%
Dem Vote -2%	-12.57%	-4.1%
Dem Vote -1%	-9.12%	-2.3%
Expected EG (Statewide Dem vote share 51.4%)	-11.12%	-4.3%
Dem Vote +1%	-11.49%	-4.2%
Dem Vote +2%	-13.49%	-6.2%
Dem Vote +3%	-8.91%	-1.8%
Dem Vote +4%	-9.30%	1.9%
Dem Vote +%5	-4.89%	2.0%

Table 2: Efficiency Gap scores for NCGA Proposed Senate Plan and Covington Proposed Senate Plan, at Democratic vote shares from 46.4% to 56.4% (one percent intervals)

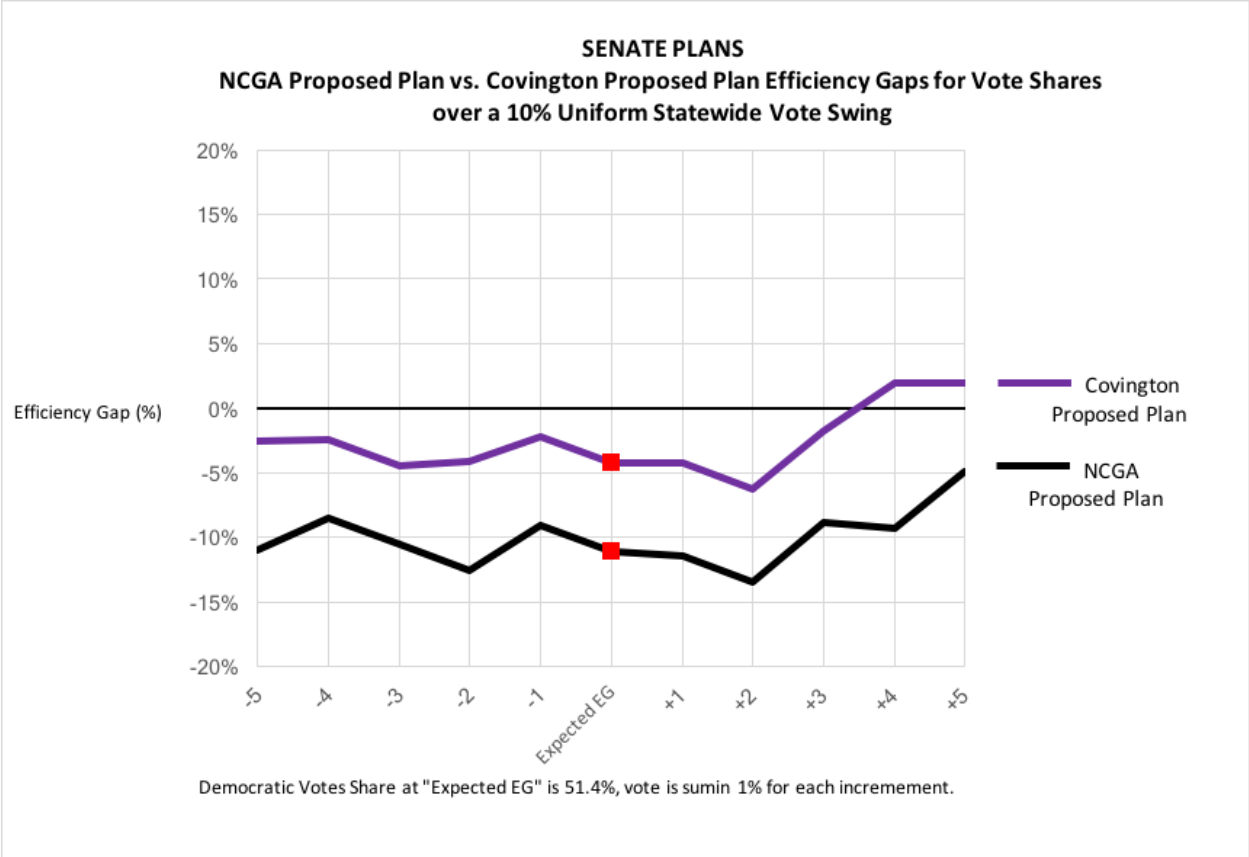


Figure 2: Efficiency Gap scores for NCGA Proposed Senate Plan vs. Covington Proposed Senate Plan at Democratic vote shares from 46.4% to 56.4% (one percent intervals)