Educational Equity in Rural Schools: Analysis of Rural Pennsylvania School Building Needs [View PDF]

Abstract

The shifting population trends across United States and Pennsylvania make it essential for policy makers to know the future enrollment trends and school building facility needs. A statewide survey was conducted and questionnaires were sent to approximately 243 school districts in rural Pennsylvania. While the majority of rural school district superintendents reported that the school building conditions were satisfactory, a sizable minority reported their building conditions were unsatisfactory. Many aging rural school buildings are not up-to-date with required maintenance. In addition, many rural Pennsylvania schools will experience severe under enrollment, at times more than 25% below their capacity. The proportion of rural schools experiencing under enrollment will differ somewhat by geographic region. Recommendations are offered regarding some policy considerations that state policymakers and school districts can utilize to improve rural school building conditions in Pennsylvania.

Given the shifting population trends across the United States and Pennsylvania, it is important for school districts to know what to expect, in terms of enrollment and facility needs, in the coming years, as the investment in school facilities plays a significant role in creating and maintaining world-class learning environments for students (Watts Hull, 2009). The Center for Rural Pennsylvania's (2012) analysis on school enrollment projections shows a mixed picture for rural districts. Between 2005 and 2012, 115 rural school districts are projected to have a significant decline in enrollment (15% or greater decline), while 10 rural school districts are projected to have a significant increase in enrollment (15% or greater increase).

Current data were subject to unexpected changes. Some rural districts with a projected significant enrollment decline experienced a significant in-migration of new residents (The Center for Rural Pennsylvania, 2012). Planning for such fluctuations in advance of changing needs is necessary in order to make effective use of resources. Compounding the matter, statistical models and surveys currently available in other states do not match the needs of Pennsylvania's rural districts (Ilsley, 2002; Neblock, 1996; Peters, 1997).

Pennsylvania is one of the most rural states in the United States. The Center for Rural Pennsylvania (2012) identifies 48 of Pennsylvania's 67 counties to be rural and 235 of the state's 500 public school districts to be rural. The Pennsylvania Department of Education (PDE) (2005) projected that enrollment in rural schools will decline; yet in-migration is causing significant population increases in some districts (The Center for Rural Pennsylvania, 2012). In both situations, consolidation or expansion of schools may require renovation and/or new construction. This major investment in school facilities, Watts Hull (2009) argues is a significant component of creating and maintaining world-class learning environments for students.

The statistics about school buildings in disrepair are alarming. About 57% of Pennsylvania schools have had at least one unsatisfactory environmental condition, 21% have had at least one building needing extensive repair or replacement, and 17% lacked the infrastructure to support technology in the classroom (Pennsylvania Department of Education, 2003). When one considers the above in light of earlier information that fewer rural than urban school districts report plans to upgrade or build facilities (National Center for Education Statistics, 2000; Simpson, 2011), there is evidence of a need to identify the specific rural districts that should plan for renovation or construction.

Regardless of the state in which schools are located, policies regarding consolidation and construction on the state level have direct impact on rural districts (Lawrence, 2001). However, there is a great need for accuracy in projecting population trends and building needs, as deferred maintenance cannot linger (Watts Hull, 2009). Non-critical maintenance projects, the crux of deferred maintenance, are performed only to the extent that funding constraints permit on an annual basis. Moreover, non-critical maintenance projects are deferred to a future period when they cannot be funded from a given school's budget for the year. Deferring any type of maintenance can lead to larger problems than the original maintenance that was required (Montgomery, 2010), which has been shown to have "devastating effects on systems such as air conditioning and heating, roofing, plumbing, and electrical systems" (Sheets, 2009, p. 101). According to Filardo, Bernstein, and Eisenbrey (2011), the accumulated backlog of deferred maintenance and repair amounts to at least \$270 billion, even by conservative estimates. Including the cost to make current school structures more environmentally efficient and using less conservative assumptions—the costs could exceed \$500 billion to complete the needed improvements to buildings and systems.

Review of School Building Capacity Research

In order to accurately determine the capacity of school buildings, several factors must be considered. Capacity can be classified in many ways, including *functional capacity* – the number of students that can be housed in a building without overcrowding, *maximum capacity* – the absolute upper bound for the number of students a building can contain, and *practical capacity* – the number of students that can be effectively educated given the school's curriculum design. No matter the original definition of capacity, Tanner and Lackney (2006) charge that what we know about capacity must continue to be challenged through ongoing research. Capacity formulas, they assert, are vulnerable to subjective variables included in the original methods of calculation (Tanner & Lackney, 2006). The original intention of measuring capacity also determines to a large extent the method of measurement that is used. These capacity definitions are vital to the analysis of building needs projections and conditions.

Functional capacity. The determination of functional capacity is calculated in order to provide insight into the appropriateness of the school building to facilitate its educational curriculum (National Center for Educational Statistics, 1999). According to the Alaska Department of Education and Early Development (2005), space must be made available to adequately support effective teaching and meaningful learning. DeJong and Craig (2000) address functional capacity as taking program issues into account when designing educational facilities. They further state, however, that adjustments to the capacity assessment must necessarily be made when considering certain *common sense* issues such as teacher preparation areas, storage, and offices that can skew the results to provide lower capacity levels than might reasonably be possible (DeJong & Craig, 2000). Many capacity calculations therefore address maximum capacity in lieu of functional capacity, opting for an outside range of values to determine appropriate numbers for addressing both overcrowding and under-utilization of school buildings.

Maximum capacity. Chan (1998) addresses the concept of maximum capacity by defining it as the product of maximum class size by total number of available classrooms. He recognized, however, the limitations produced by determining school building capacity in this manner. Keeping these possible snares in mind, an approach to calculating capacity that considers all appropriate influences including curricular approaches and specific facility conditions was utilized in this study. The type of calculation that best approximates the actual ability of school facilities to utilize space to a given capacity is by finding practical capacity (Chan, 1998; Tanner & Lackney, 2006).

Practical capacity. In addressing the issue of capacity, DeJong and Craig (2000) stated that the formula for calculating capacity should be an accurate reflection of the programs that are accommodated in public schools, yet as simple as possible for planning purposes. The Alaska Department for Education and Early Development (2005) indicated that, in addition to accurately reflecting the curricular programs, the school environment should also consider the necessity of preserving cultural pluralism and maintaining a local cultural identity. Several studies indicate that community utilization of public school building facilities should also be a factor in determining school building size; school-day student capacity is but one measure in planning facilities (California Department of General Services, 2006; Chan, 1998; DeJong & Craig, 2000).

Methods of calculation. Each of the above capacity values can be determined in multiple ways, depending on the intended use of the data. Often calculated capacity levels are used to determine reimbursement issues, in which case a larger number of students are desirable. If, however, the building capacity totals are used to project need, as is the aim of this study, one must be cautious to err on the side of conservative figures.

The predominant method of calculating school building capacity is based on the number of students that can be effectively instructed in various classroom settings (North Carolina Department of Public Instruction, 2006; Pennsylvania Department of Education, 2005). Depending on the curricular approach, classrooms, lunchrooms, libraries, and gymnasiums are able to accommodate a certain number of students per instructor. This approach takes into account the type of classroom: special education, fine arts, etc., and permits accommodations to be made in order to determine practical capacity as defined earlier. In my research on school building facilities, each type of classroom and educational space was delineated in order to effectively address the ability of the building to accommodate the maximum number of students.

Statement of the Problem

Local municipalities and the state of Pennsylvania spend a great deal of fiscal and human capital on maintaining school facilities in rural areas. To effectively do this, districts must be able to accurately assess the need to invest in existing structures or create new building projects based on shifting population numbers of people across the state. Research in this study provides population trend information to help prepare for either of two scenarios: consolidation and/or renovation of schools made necessary by declines in student populations, or renovation/new construction in order to accommodate an influx of students. The research conducted can be adapted or used by districts or state departments when schools are being closed and rebuilt in particular locales, much like the work Sheets (2009) conducted in rural schools in Texas.

Major concerns in rural Pennsylvania schools are related to "energy inefficiencies, unsafe drinking water, water damage and moldy environments, poor air quality, inadequate fire alarms and fire safety, compromised building security, and structural dangers" (Filardo, Bernstein, &

Eisenbrey, 2011, p. 1). The National Center for Education Statistics (1999) reported rural schools across the U.S. to be, on average, 41 years old, with 28% of schools built before 1950 (Hunter, 2009). Recent research confirms this as well (Filardo et al., 2011). Watts Hull (2009) found a great deal of schools built during the construction boom of the 1930-1950s is now in a period of "tenuous functional existence as costs for renovations and repairs begin to eclipse the cost of replacement" (p. 1). This indicates that a number of schools may be in need of renovation in order to accommodate recent technology and the handicap needs of their students.

Furthermore, technology lags behind in districts outside of urban areas in Pennsylvania. Fewer rural school facilities have Internet and technology access relative to urban sites (NCES, 2002). This supports the importance of examining the current capabilities of school buildings within districts, analyzing population trends, and preparing in advance for population shifts. Existing facilities may need to be updated and new ones may need to be outfitted with necessary and costly equipment. In Pennsylvania and across the country, the input costs of building and renovation, from steel to concrete, are rising to a level that makes it important that districts plan carefully to meet upcoming needs (Sack, 2004). Another issue that makes it important for school districts to prepare for future needs is the changing face of student learning environments. Such elements as technology readiness and current instructional requirements are critical elements of appropriate and effective instruction in the 21st century (Sheets, 2009).

Purpose of the Study

This study sought to address four critical needs of rural school districts. First, the study conducted an inventory of the state's school buildings that included their age, physical condition, telecommunications readiness, and other relevant indicators related to the cost of maintaining, upgrading, or replacing facilities. Currently, no such specific information is readily available that targets rural schools.

Second, this study conducted an analysis of enrollment trends to identify whether school buildings in rural school districts will meet future needs. While some data about enrollment trends were available at the state level, no such information exists on a district level for rural schools.

Third, with the high costs of construction, school districts need to carefully pinpoint areas of need. There is a need to identify those school districts that will be at risk of under- or over-capacity or utilization. Currently, this information is unavailable through national or state data sources.

Finally, no instrument exists that will assist school districts in determining future building needs. The information gathered by this study led to the development of a statistical model that will help school districts plan effectively for building projects and/or consolidation.

Research Questions

The following questions guided the research:

- What are the current conditions (age, physical condition, telecommunications readiness, and other relevant indicators related to the cost of maintaining, upgrading, or replacing facilities) of school buildings in the state of Pennsylvania?
- What are the enrollment trends of students in Pennsylvania at both the district and state level?
- Which school districts are at risk of under- or over-capacity or utilization?

Methodology

A Survey of Statewide Rural School Districts Building Conditions

Survey instrument development. The School Building Condition Questionnaire was developed through three stages: (a) survey item pool development, (b) content validity check, and (c) pilot test of survey items.

To develop a survey item pool, a literature review was conducted to identify critical issues and information related to building facilities and conditions in schools located in rural areas. This information was then aligned with the project's goals and objectives and incorporated into preliminary survey items based on each objective.

To check the content validity of the preliminary instrument, five school superintendents and principals who have rich experiences in school facility management were invited to make comments on the content and clarity of the survey. In order to assess the feasibility of the survey instrument, a pilot study was conducted using the survey instrument in Northwestern Pennsylvania at Intermediate Unit IV. Invitations to participate were sent to 14 rural school districts in the Intermediate Unit. Follow up phone calls, as well as a focus group discussion meeting with dinner provided, enabled me to receive input from five different districts, with a variety of personnel represented. Various representatives including administrators and maintenance personnel provided valuable input regarding the form and format of the instrument, as well as the makeup of the questions.

Acting on feedback from the pilot test, two types of survey items were rewritten: one related to content clarity and the other related to response variability. For the first type of revision, about 10 of the survey items were subsequently rewritten to eliminate unclear and vague language. Eight survey items were rewritten to avoid double-barreled items. For the second type of revision, five "weak' items were found to yield little or no variability in responses. These items were rewritten so that each became sensitive to differences among respondents' opinions.

Survey instrument. The final version of the survey instrument was divided into two sections: (a) Characteristics of Rural School Districts, and (b) Inventory of Existing School Building Conditions.

The "Characteristics of School District" section asked information on the characteristics of individual buildings in rural school districts: (a) names and number of buildings, (b) location of buildings, (c) grade levels included in each building, and (d) student enrollment in each building.

The "Inventory of Existing Conditions" section obtained information on the physical condition and capacities of each individual building within the school district. The following were addressed:

Building age. Many rural schools have been renovated in the years since they were built. For this reason, the year of the most recent renovation is often a better basis of a school's age than the year of original construction. Therefore, the years of major renovation projects were also collected.

Physical condition. The physical condition of school buildings was rated for each of the following categories: (a) environmental factors, (b) major building features, (c) building safety, (d) minor building features, (e) building accessibility, and (f) energy efficiency of building.

Information of several environmental factors in rural school buildings was collected: air quality, air filtration system, local exhaust system, heating system, air conditioning, and acoustics control of buildings. Four major features in rural school buildings include (a) roof; (b) foundations; (c) drywall, plaster, and bricks; and (d) exterior and interior walls. Four minor features include: (a) interior water supply, (b) exterior water supply, (c) lockers, and (d) male/female restrooms. Information about rural school building safety includes: (a) fire alarms, smoke detectors, and sprinkler systems; (b) light sources; and (c) emergency lighting. The information on energy efficiency in rural school building energy efficiency. Finally, the survey asked information about the following building accessibility features: (a) handicapped accessibility, (b) vehicular entrances and exits, (c) pedestrian services, (d) student drop-off area, and (e) bus loading area.

The survey questions were designed to be used by the district superintendent as a guide for observing and assessing school building conditions. The survey responses reflect the perceptions of the school district superintendent on school building condition, but are not intended to be used as strict objective measures. To minimize subjective ratings by surveyors, the following five point scale was used to rate the quality of school building conditions for each survey item: (a) Excellent: new or easily restorable to "like new" condition; only minimal routine maintenance required; (b) Satisfactory: only routine maintenance or minor repair required; (c) Borderline: fails to meet code and functional requirement in some cases, failure(s) are inconvenient, extensive corrective maintenance and repairs are required; (d) Poor: consistent substandard performance; failure(s) are disruptive and costly; fails most code and functional requirements; requires constant attention, renovation, or replacement; major corrective repair or overhaul required; and (e) N/A: not applicable.

The "Building Capacity" section collected information on the number of rooms in (a) standard learning space, such as regular classrooms, special education classrooms, and science classrooms or laboratories; and (b) support facility space, such as business classroom, music and art rooms, and gymnasiums.

Measure of School Building Capacity

To accurately assess the school building capacity, the PDE enrollment projection data and PlanCon data were utilized. The PlanCon data provided a standard unit capacity for calculating building capacities. For example, the unit capacity for half-time kindergarten is 50 students and the unit capacity for full-time kindergarten is 25. Classroom capacity is normally calculated on the basis of 25 students per regular classroom. Other values are assigned to laboratories, gymnasiums, art rooms, music rooms, etc.

Using these data, the school building capacity can be calculated according to the following formula:

Elementary School Building Capacity = $[\sum (Number of Instructional Unit) \times (Unit Capacity)].$

Secondary School Building Capacity = $[\sum (Number of Instructional Unit) \times (Unit Capacity)] \times (Building Utilization Factor)$

Data Collection Procedures and Strategies

The following strategies were used in the data collection procedure to increase the return rate: (a) both online survey and mailing survey, and (b) various follow up strategies.

According to the definition of the Center for Rural Pennsylvania (2012), a school district is rural when the number of persons per square mile within the school district is less than 274; approximately 235 school districts in Pennsylvania are categorized as rural school districts. For these rural school districts, a master contact list including district superintendent names, building addresses, phone numbers, and e-mail addresses and/or websites was developed. Based on the master list, all districts were contacted via telephone to confirm their email address. This list was then updated and cross-checked on a regular basis.

Various follow up strategies were used to ensure that the survey was directed to the superintendents. Those who received the survey were reminded to return their survey, and those who did not respond were requested to provide their preferred method of survey completion. These contacts were noted in the contact log, as well as their preferred method of transmission of the survey. A total of 141 (58%) of the districts on the contact list were sent surveys using both the online and hard copy.

Superintendents or other district-level personnel, such as Business Managers or Supervisor of Special Projects completed the surveys. A total of 65 school districts returned the surveys either via email, fax, or regular mail. The response rate for the survey was 27% (65/243).

In addition to the survey constructed for this project, the existing PlanCon data from the Pennsylvania Department of Education (2005) were utilized. PlanCon data requires school districts to provide information for their school conditions, it provided information for validating the data that were collected from the survey and also provided school condition information for those school districts that were not included in the survey. Combined, the PDE PlanCon data and the survey data, a total of 126 school districts were included in the analyses of school building conditions. These school districts represented 52% of the rural school districts in Pennsylvania.

Representative of the Data Source

Two important indicators of school characteristics were used throughout the comparisons of this study: Region and percentage of low-income students. Prior literature indicated that school enrollment projections and school building conditions were significantly related to these two factors (NCES, 2000, 2002, 2005; The Center for Rural Pennsylvania, 2012). The PDE website provides percentage of low-income students on their website for each school district: http://www.pde.state.pa.us/k12statistics/cwp/view.asp?A=3&Q=139940. Data from the Center of Rural Pennsylvania (2005a) were utilized to group rural Pennsylvania school districts into Eastern, Central, and Western region. Combining the percentage of low-income student data with the region data, the school characteristic data for rural school districts was created.

To assess the representative of our sample to the target sample, the school district characteristics were compared between the school districts that were included in the analysis and those school districts that were not included in terms of their regional distribution and concentration of low-income students. As indicated in Table 1, a Chi-square test result revealed that there were no significant differences between the school districts that were included in the

study with those that were not included in terms of their regional distribution, χ^2 (2, N = 243) = 0.20, p = .90. The percentage of low-income students in the school districts that were included in the study did not differ with those of the school districts that were not included, χ^2 (3, N = 243) = 1.05, p = .79.

Even though these two school characteristics were not significant, there is a possibility of response bias for the data, besides student poverty rate and region, since only 52% of rural school districts were included in the analysis.

Table 1

Comparison of School Characteristics for School Districts Included in Study with Those Not Included

School Characteristics	School Districts Included				
	No (n = 117)	Yes (n = 126)			
Region					
West	51 (43.6%)	56 (44.4%)			
Central	42 (35.9%)	47 (37.3%)			
East	24 (20.5%)	23 (18.3%)			
	$\Box^2 = 0.20, d$	f = 2, p = .90			
Percentage of low-income students					
Less than 20%	19 (16.2%)	21 (16.7%)			
20 to 29%	30 (25.6%)	34 (27.0%)			
30 to 39%	42 (35.9%)	38 (30.2%)			
40 and above	26 (22.2%)	33 (26.2%)			
	$\Box^2 = 1.05, df = 3, p = .79$				

Note: Percentages are computed across each column, but may not sum to 100 by rounding.

Findings

Building Conditions

Building environmental conditions. Environmental conditions, such as heating and air conditioning, are important aspects of the day-to-day environment for student learning. The Survey on Rural School Building Conditions collected perceptions of the district superintendents with various environmental conditions in rural school buildings. The conditions that were rated included indoor air quality, air filtration system, local exhaust system, heating system, air conditioning, and acoustic control of buildings. While the majority of rural school district superintendents reported that the environmental conditions in their schools were satisfactory (about 50% were satisfactory and 30% were excellent), a sizable minority reported their environmental conditions were unsatisfactory (about 8% were borderline and about 5% were poor).

Acoustics were rated as unsatisfactory by more schools than any other environmental condition; with approximately one-fifth of schools indicating their acoustics were unsatisfactory.

One-sixth of schools reported that their heating system was unsatisfactory. Fifteen percent of schools were unsatisfied with indoor air quality. About 12-13% of schools were unsatisfied with the air filtration system and local exhaust system. Only 7% of schools indicated that their air conditioning was unsatisfactory.

The Chi-square test results revealed that the rural school district superintendents' satisfaction ratings with the environmental conditions show some variation by school characteristics. For example, they were more unsatisfied with their high school local exhaust system than elementary schools (10% rated as poor versus 15% rated as borderline), χ^2 (3, N = 126) = 15.07, *p* < .001. School district superintendents in Central areas were more unsatisfied with their local exhaust system than schools in Western and Eastern areas (27% versus 8% and 5%), χ^2 (6, N = 126) = 27.82, *p* < .001. However, the rural school district superintendents' satisfaction ratings with indoor air quality condition and air conditioning did not show any variation by school characteristics with regard to instructional level, region, and percentage of low-income students (all *ps* > .05).

Building conditions: Major features. The Survey on Rural School Building Conditions collected information about satisfaction with four major features in rural school buildings: (a) roof; (b) foundations; (c) drywall, plaster, and bricks; and (d) exterior and interior walls. The majority of rural school district superintendents reported that the foundation, drywall, plaster, and bricks; and exterior and interior walls in their schools were satisfactory (over 50% were satisfactory and over 23% were excellent). The condition of the schools' roofs was rated as lowest in these major building features. Approximately a quarter of the respondents indicated their schools' roof was unsatisfactory.

The rural school district superintendents' satisfaction ratings with roofs, foundations, and walls did not vary significantly by school characteristics, such as instructional level, region, and percentage of low-income students (all ps > .05). However, rural school district superintendents' satisfaction ratings with drywall, plaster, and bricks show some variation by region and the percentage of low-income students. For example, school district superintendents in Western and Central areas were more unsatisfied with their drywall, plaster, and bricks than school district superintendents in Eastern area (24% and 25% versus 0%), χ^2 (6, N = 126) = 16.01, p = .01. In addition, school district superintendents were more likely to report drywall, plaster, and bricks as satisfactory for more affluent schools (schools with less than 20% low-income students) than for less wealthy schools (schools with the higher concentration of low-income students), 93% versus 55%, χ^2 (9, N = 126) = 22.52, p = .01

Building conditions: Minor features. The Survey on Rural School Building Conditions Survey collected information about satisfaction with four minor features in rural school buildings: (a) interior water supply, (b) exterior water supply, (c) lockers, and (d) male/female restrooms.

Over 90% of rural school district superintendents reported that their interior/exterior water supply and lockers were satisfactory (over 50% satisfactory and over 40% excellent). Approximately 89% of rural school district superintendents reported their male and female restrooms to be satisfactory or excellent.

The Chi-square test results revealed that the rural school district superintendents' satisfaction ratings with interior water supply and lockers did not vary significantly by school characteristics, such as instructional level, region, and percentage of low-income students (all *ps* > .05).

However, rural school district superintendents' satisfaction ratings with exterior water supply show some variation by the percentage of low-income students. School district superintendents were more likely to report their exterior water supply condition as borderline for schools with 40% and above low-income students than for those more wealthy schools (schools with the lower concentration of low-income students), 16% versus 10%, $\chi^2(9, N = 126) = 20.51$, p = .02.

Rural school district superintendents' satisfaction ratings with male/female restrooms show some variation by region and the percentage of low-income students. For example, school district superintendents in the Eastern areas were less likely to rate their male/female restrooms with unsatisfactory than schools in the Western and Central areas, 5% versus 9% and 17%, χ^2 (6, N = 126) = 17.79, p = .01. School district superintendents were more likely to report male/female restrooms were unsatisfactory for affluent schools (those with less than 20% lowincome students) than for less wealthy schools (schools with the higher concentration of lowincome students), 20% versus 13%, χ^2 (9, N = 126) = 19.50, p = .02.

Building safety conditions. The Survey on Rural School Building Conditions collected information about satisfaction with building safety in: (a) fire alarms, smoke detectors, and sprinkler systems; (b) light sources; and (c) emergency lighting.

About 97% of rural school district superintendents reported that the fire alarms, smoke detectors, and sprinkler system in their schools were satisfactory (36% satisfactory and 62% excellent). About 88% of rural school district superintendents reported that the light sources in their schools were satisfactory (51% satisfactory and 37% excellent). Approximately 90% of rural school district superintendents reported that the emergency lighting in their schools was satisfactory (59% satisfactory and 31% excellent).

The Chi-square test results revealed that the rural school district superintendents' satisfaction ratings with building safety did not vary significantly by school characteristics, such as instructional level, region, and percentage of low-income students (all ps > .05).

Conditions of building energy efficiency. The Survey on Rural School Building Conditions collected information about satisfaction with energy efficiency in rural school buildings on: (a) fluorescent lighting, (b) building envelopes, and (c) building energy efficiency.

While more than 60% of rural school district superintendents reported that the building energy efficiency in their school buildings was satisfactory, more than 30% of school district superintendents reported that building energy efficiency was unsatisfactory.

The Chi-square test results revealed that rural school district superintendents' satisfaction rating with building energy efficiency did not show any variation by school instructional level and the percentage of low-income students, (all ps > .05). However, rural school district superintendents' satisfaction ratings with building energy efficiency show some variation by region. For example, school district superintendents in the Eastern area were more satisfied with their building energy efficiency than school district superintendents in the Western and Central areas, 68% versus 28% and 35%, χ^2 (6, N = 126) = 19.59, *p* <.01.

Conditions of building accessibility. The Survey on Rural School Building Conditions collected information about satisfaction with the following building accessibility features: (a) handicapped accessibility, (b) vehicular entrances and exits, (c) pedestrian services, (d) student drop-off area, and (e) bus loading area.

The majority of rural school district superintendents reported their handicapped accessibility, vehicular entrances and exits, pedestrian services, and bus loading area were satisfactory (over 40% satisfactory and over 30% excellent). Student drop-off area was rated as

lowest, and one-third of school district superintendents reported that student drop-off area was unsatisfactory.

The Chi-square test results revealed that the rural school district superintendents' satisfaction ratings with building accessibility did not vary significantly by school characteristics, such as instructional level, region, and percentage of low-income students (all ps > .05).

Functional Age of School Building and School Building Conditions

Functional age of school building. Rural school buildings tend to be older than the national average age of schools (41 years), with an average age of 44 years (SD = 17.5). Many rural schools have been renovated in the years since they were built. For this reason, to accurately determine the school building age, a functional age was used for this study. For schools that have completed major renovation projects, functional age was identified as the number of years since the completion of such projects. The average functional age of schools, as defined above, was 16 years (SD = 11.5). Fifteen percent of rural schools had a functional age of 35 years or more.

One-way ANOVA tests showed the rural schools' functional age did not show any variation by school characteristics with regards to region, F (2, 123) =1.24, p=.29, and percentage of low-income students, F (3, 122) =.62, p= .60. However, there was some variation in the functional age distributions by school instructional level, F (1,124) = 5.03, p = .03. The average functional age of secondary schools is smaller than the average functional age of elementary schools (13 years versus 18 years).

Functional age of school building and school building conditions. Previous studies reported that school age and condition are closely related, with older schools being in worse condition than newer schools (NCES, 2000). In addition to examining the average functional age of schools, schools were further divided into four groups based upon the distribution of schools across different functional age groups. Overall, about 22% of rural schools had a functional age of less than 5 years, 29% had a functional age of 5 to 14 years, 34% had a functional age of 15 to 34 years, and 15% had a functional age of 35 years or more.

The relationship between the functional age of schools and school building conditions was further examined by Chi-square tests in: (a) environmental factors, (b) major building feature, (c) building safety, (d) minor building features, (e) building accessibility, and (f) building energy efficiency. The Chi-square test results revealed that school district superintendents were more likely to report environmental factors (indoor air quality, air filtration system, local exhaust system, heating system, air conditioning, and acoustic control of buildings) in old schools (with functional ages of 35 years or more, and those aged 15 to 34 years) in poor condition than those in newer schools with functional ages of less than 5 years or 5 to 14 years (all ps <.01). None of the environmental factors in the schools aged 35 years or more were reported by their school district superintendents as in excellent condition.

The Chi-square test results revealed that school district superintendents were more likely to report major building feature conditions (roof, foundation, and walls) to be unsatisfactory (in poor and borderline condition) for old schools (with functional ages of 35 years or more, and those aged 15 to 34 years) than for newer schools with functional ages of 5 to 14 years or less than 5 years, (all ps < .01). The roof conditions in over half of schools with functional ages of 35 years or more were reported by their school district superintendents as poor or borderline conditions.

Older schools typically have worse building safety conditions and building energy efficiency features than newer schools. About 18% of schools with functional ages of 35 years or more were reported to have poor conditions for their fire alarms, smoke detectors, and sprinkler systems. About 23% of schools with functional ages of 35 years or more were reported in borderline condition for their emergency lighting. More than 80% of schools with functional ages of 35 years or more, and 48% of schools aged 15 to 34 years were reported in poor and borderline condition for their building energy efficiency condition.

About half of schools with functional ages of 35 years or more were reported as unsatisfactory for their building accessibility, such as handicapped accessibility, vehicular entrances, and exits. The student drop-off area conditions in over 70% of schools with functional ages of 35 years or more were reported in poor and borderline condition.

Predictions for Future Building Needs

A statistical model was developed to identify the future building needs. The future building needs are examined by the degree to which school enrollments currently differ from the number of students the school is designed to accommodate (building capacity) and the projected enrollment number.

This analysis includes four steps: (a) determining the school building classification; (b) calculating school capacity for elementary schools; (c) calculating school capacity for secondary schools, and (d) comparing district enrollment to school capacity and identification of the future needs of school buildings.

Using the following formula, a proportion is calculated to determine future building needs:

Future Building Needs = $[1 - (Prediction of School Enrollment)/(Building Capacity)] \times 100$

Using this formula, schools with enrollments within 5% of building capacity are considered neither under-enrolled nor over-crowded. When the value of the proportion is greater than 5% and positive, student enrollment is considered less than the building's capacity, and the school is considered under-enrolled. When the value of the proportion is over 5% and negative, the enrollment exceeds the building's capacity, and the school is considered over-crowded (or over-enrolled).

Following the method used by NCES (2000), the degree of under-enrollment or overcrowded could be further grouped into one of five categories: (a) significantly under enrolled (more than 25% under-enrolled), (b) moderately under-enrolled (6- 25% of under-enrolled), (c) at capacity (enrollment within 5% of capacity), (d) moderately over crowed (6-25% of overcrowded), and (e) significantly over crowed (more than 25% over-crowded).

Prediction of elementary school building needs. Percentage Distribution of Elementary School Building Utilization by School Characteristics is presented in Table 2. As shown in Table 2, more than half of rural elementary schools (58%) will experience severe under-enrollment in the next five years (more than 25% under-enrolled). More than 20% of rural elementary schools will experience moderately under-enrolled (6-25% of under-enrolled). To further examine the relationship between elementary school building needs and school characteristics, Chi-square tests were performed for rural elementary schools that will experience under-enrollment. Elementary schools that have enrollment within 5% of capacity or over crowded were not included in the analysis, because the expected value of those schools are too small, which would

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violate an assumption of Chi-square test. The Chi-square test results revealed that the proportion of elementary schools experiencing under-enrollment in the next five years would not vary significantly by school characteristics, such as region and percentage of low-income students (all ps > .05).

Table 2

Elementary School Building Utilization by School Characteristics

School Characteristics	Under-Enrolled				Enrollment within		Over-Crowded			
	25%+		6-25%		5% of capacity		25%+		6-25%	
	n	%	n	%	n	%	n	%	n	%
Region										
West	41	70.7	12	20.7	3	5.2	2	3.4	0	0.0
Central	24	51.1	9	19.1	7	14.9	6	12.8	1	2.1
East	8	38.1	6	28.6	2	9.5	3	14.3	2	9.5
Percentage of low- income students										
Less than 20%	9	42.9	5	23.8	2	9.5	4	19.0	1	4.8
20-29%	15	44.1	10	29.4	6	17.6	2	5.9	1	2.9
30-39%	27	71.1	4	10.5	3	7.9	4	10.5	0	0.0
40% and above	22	66.7	8	24.2	1	3.0	1	3.0	1	3.0

Note: 1. "Under-enrolled" indicates that the capacity of the school buildings is greater than student enrollment by more than 5%.

2. "Over-crowded" indicates that the enrollment of the school is greater than the capacity of the school buildings by more than 5%.

3. Percentages are computed across each row, but may not total 100 when rounding.

4. "n" represents the numbers of school districts. Total number of school district is 126.

Prediction of secondary school building needs. Percentage Distribution of Secondary School Building Utilization by School Characteristics is presented in Table 3. As shown in Table 3, the majority of rural secondary schools (82%) will experience severe under-enrollment, with enrollment at more than 25% below building capacity. To further examine the relationship between secondary school building needs and school characteristics, Chi-square tests were performed for rural secondary schools that will experience under-enrollment. Secondary schools that have enrollment within 5% of capacity or over crowded were not included in analysis, because the expected value of those schools are too small, which would violate an assumption of Chi-square test. The Chi-square test results revealed that the proportion of secondary schools experiencing under-enrollment in the next five years will differ somewhat by geographic region, $\chi^2(2, N = 119) = 7.26$, p = .027. Approximately 90% of secondary schools in the West and more than 80% of secondary schools in Central Pennsylvania will be more likely to be severely under-enrolled. On the other hand, approximately 10% of secondary schools in the East will be more likely to be severely over-crowded (enrollments that will be more than 25% greater than their

capacity). However, the proportion of secondary schools experiencing under-enrollment in the next five years will not differ by the percentage of low-income students in the school (p > .05).

Table 3

Secondary School Building Utilization by School Characteristics

School Characteristics	Under-Enrolled				Enrollment within		Over-Crowded			
	25%+		6-25%		5% of capacity		25%+		6-25%	
	n	%	n	%	n	%	n	%	n	%
Region										
West	52	89.7	3	5.2	1	1.7	2	3.4	0	0.0
Central	39	83.0	8	17.0	0	0.0	0	0.0	0	0.0
East	12	60.0	5	25.0	1	5.0	1	0.0	2	10.0
Percentage of low- income students										
Less than 20%	14	66.7	5	23.8	1	4.8	0	0.0	1	4.8
20-29%	25	75.8	5	15.2	1	3.0	2	6.1	0	0.0
30-39%	36	94.7	2	5.3	0	0.0	0	0.0	0	0.0
40% and above	28	88.8	4	12.1	0	0.0	0	0.0	1	3.0
All Rural Schools	103	82.4	16	12.8	2	1.6	2	1.6	2	1.6

Note: 1. "Under-enrolled" indicates that the capacity of the school buildings is greater than student enrollment by more than 5%.

2. "Over-crowded" indicates that the enrollment of the school is greater than the capacity of the school buildings by more than 5%.

3. Percentages are computed across each row, but may not total100 when rounding.

4. "n" represents the numbers of school districts. One small rural school district has only one building, which was already analyzed in the table 2. The total number of school district is 125.

Policy Considerations

The issue of adequate access to education in rural areas is one of great concern to policy makers. As more students enter U.S. schools, the population is changing rapidly in many districts. Yet, as school buildings age, districts are budgeting less on maintenance than they have in the past (Lawrence, 2003). State policy makers and school districts all have an important role to play in building effective rural schools. However, the discussions need to be more inclusive. The departments of health and environmental quality, and members of state legislature must be involved as well as local education agencies, parents, and local health officials in the conversations about creating standards for school buildings (Watts Hull, 2009). Based on the findings of this study, this section puts forth policy considerations that state policymakers can take to improve the rural school building conditions.

Effectively monitoring and regularly assessing school building conditions. While the majority of rural schools in the survey reported that their school building conditions were satisfactory, a sizable minority reported their building conditions were unsatisfactory.

Approximately a quarter of schools indicated that their roof was in poor or borderline condition. More than 30% of schools reported that their building energy efficiency was unsatisfactory, and one-third of schools reported that their student drop-off area was in poor or borderline condition.

Assessments of building and site condition, design, and utilization are not available at the national level (Filardo, 2008). However, to effectively monitor and enhance the school facilities' conditions in rural Pennsylvania, state policy makers should create a comprehensive set of minimum standards for facilities' conditions and conduct an ongoing inventory assessment of statewide facilities. By providing an inventory of existing conditions among rural schools in Pennsylvania, policymakers will have the details they need to make informed decisions about future educational needs. Such practices will ensure that policymakers, parents, and other stakeholders are aware of deficiencies in school conditions and their capacity so that funds can be directed to the neediest schools.

Policy makers should also establish regulations and tools to facilitate school districts to regularly evaluate and estimate their school building conditions and release their evaluations to the public. Currently, the review of school building conditions is left up to each district. At the state level, there are no requirements to do this on a regular basis. Most districts include a section on buildings and grounds in their 5-year strategic plans but they are not bound to complete anything in those plans. Most districts just make very general comments regarding their intentions and none really go through the formal process that PDE requires. Only if they seek reimbursement through the PDE for any renovation or construction projects are they required to formally evaluate the conditions of their buildings. Policies and laws need to be formed in order to change the current mechanism of school building condition review both on the school district level and on the state level.

To gain support from the community, policy makers should also encourage school districts to provide a clear estimate of what its building construction or repair needs are, along with a plan for raising the funds necessary to meet their building needs. The evaluation should provide information about the building's age, physical condition, telecommunications readiness, safety accessibility, and energy efficiency. Watts Hull (2009) cites how energy prices have increased dramatically and schools have had to deal with the ever-increasing utility costs eating away at a larger share of their budget. The estimate from the school district could in turn provide critical information to state level policy makers, lawmakers, as well as school districts and communities as they plan for changes in rural environments.

Rethink under-utilized school buildings and maximize public use of school facilities. As a result of this population shift, state policy makers and rural school administrators should take into account that many rural schools enroll far fewer students than they have space for; which is under-utilizing current facilities. As the survey results indicate, elementary and secondary schools in Western and Central Pennsylvania will be more likely than those in the East to be severely under-enrolled. Taking full advantage of school buildings with extra space to meet today's educational program needs is an important challenge for rural school districts.

State policy makers could consider facilitating school districts to consolidate schools and shift some programs to different schools. To do this, strategies need to be established for school districts to update and examine attendance records and plans for entire school buildings. Consolidation of special populations of students, or slightly shifting students among buildings might allow school districts to distribute students more evenly across school buildings.

State policies should also be made to encourage school districts to take advantage of extra space in their buildings to offer special programs that could attract more students from surrounding school districts. Special programs can be those that other schools do not offer, such as a variety of special education programs (behavior support, anger management, emotional support, life skills). Generally, smaller districts are not able to offer these programs and any district offering these courses can charge tuition and a fee to those districts that will send students to the host districts. These schools alone would not have enough students to offer these programs, but together, one school can group students from several school districts and provide classroom space for these special programs. Other such special programs could be prekindergarten. This includes renting space to a pre-school or to a special tutoring assistance program run by private groups who need space and are willing to go where the students are located. Extra space in the school could provide opportunities for new and/or additional sources of funds for financing building improvements. Schaefer (2010) notes that elementary schools already in existence are being transformed for the purpose of serving the greater community. Policy makers should encourage and regulate under-utilized schools to offer more after-school programs and weekend activities to establish stronger relationships with the community, and to make rural schools the true centers of the community.

The community leaders could also be encouraged by policies to take advantage of the school facility as a community asset. Certain state plans should be made to promote local communities to work with school districts in terms of looking for ways to utilize the school facilities and creatively support or finance the shared programs such as adult education, job training, technology training, and health fitness centers, in order to make the school buildings become community centers as well. The regulated plans could include formal and informal gatherings among the community members, lectures, town hall meetings, banquets, and celebrations, according to Schaefer (2010).

While a majority of schools in the West and Central Pennsylvania will be severely underenrolled, about 10% of schools in the East will be more likely to be severely over-crowded (enrollments that will be more than 25% greater than their capacity). To effectively utilize the school building facilities, state policy makers should drive school district administrators and community leaders to work together. Parents and community leaders know their children's needs better than outside architects ever could. Involving the community in school building planning is a good way to build public support for school building improvement plans. Taxpayers who pay the bill for school improvements should know how their money is to be spent.

Understand the changing face of student learning environments and future building needs. Another issue that makes it important for state policy makers to prepare for future needs is the changing face of student learning environments. As our study results indicate, many rural schools appeared to be under-utilized; however, state policy makers and school district administrators should be aware that the designed school building capacity might overestimate the ability the school building could allow in the "real world." School buildings' legal capacity is oftentimes breached or under-utilized which is usually not permitted in other "real world" venues. School events create cases when there may be more students in the designed building than actually allowed under current building capacity codes. For example, a school's auditorium has a capacity set by the Department of Labor and Industry for 600 but for special events, the auditorium seated over 700 with additional seating. The flip side is also true. Due to declining enrollments in rural schools, the original building may have been built for 1000 but there may

now be educating only 600 students. This leads to a significant amount of wasted space, which is usually not tolerated in "real world" businesses.

The current PDE formula for school capacity does not always account for the full range of programs that may be offered in rural schools. For example, federal regulations require a limited number of students with special education needs in the classroom. With current inclusion practices, the special education students are mainstreamed back into regular classrooms. This situation not only requires the school administration to effectively use classrooms, but also challenges the current PDE school capacity formula, which did not consider this factor.

Also, current instructional methods encourage many "hands on" activities, which require more space in the classroom. Many old buildings in rural schools were originally designed as fixed rows of desk arrangement for whole class lecture types of instructional mode. To accommodate the new instructional methods of small group and hands-on activities, the future school capacity formula should also consider this challenge.

Technology improvements could also reduce the number of seats that may reasonably fit into a regular classroom. For example, current technology improvement requires more computers in the classroom, which may also take more space than the traditional desk arrangement.

Address the uniqueness of rural issues related to rural school building needs. Deferred maintenance in small rural schools "affects the morale, achievement, health and safety of everyone who uses them" (Lawrence, 2003, p. 15). This puts the school in danger of closing in some cases. First, funding is the main concern for rural school districts to maintain and upgrade their school facilities. Many funding formulas for school construction projects are based on the number of students. Rural schools usually have a small enrollment, and experience further enrollment decline, which put rural schools at a disadvantage when applying for grants and funding. As the findings of the study indicate, a majority of rural schools will experience a significant enrollment decline. Based on the current funding policy, they will have less construction money available. Also rural school districts tend to have lower property values, which lead to less money available to borrow. Smaller or less wealthy rural schools face more severe challenges. The state policy makers should continue to expand funding for rural school construction and expand commitment to rural schools, which experience the financial strain of improving school building conditions.

Second, school facilities are not just about the number of classrooms, it is also about the quality of the learning environment. To meet today's educational program needs, rural school districts have unique challenges. Transportation is a key cost issue in rural areas, particularly regarding the loss of instructional time transporting students. Urban school districts, serving denser populations, would probably not share facilities as much because they have enough students to fill special programs and most students walk so they do not lose instructional time bussing students. Rural schools may also need to have before and after-school programs because of the distances rural students must travel to get to school and return home. This is not necessarily true of urban schools. Thus, some rural schools may need to house students for longer periods of time to have a variety of ages of students for long periods of time.

Third, rural school buildings are challenged by demands to meet federal mandates. Many aging rural schools experience problems with energy efficiency and other environmental conditions that interfere with classroom learning. Fifteen percent of rural schools in the survey had a functional age of 35 years or more. None of these schools reported their environmental

factors were in excellent condition. About 20% of these schools reported the air conditioning in poor condition. More than 80% reported their building energy efficiency condition in poor and borderline condition. About half of these schools reported their handicapped accessibility, vehicular entrances, and exits as unsatisfactory. Over 70% reported their student drop-off area condition in poor and borderline condition.

As discussed, over time, deferred maintenance and repair can cause a myriad of problems for schools and school districts (Montgomery, 2010). School buildings constructed in the 60s and 70s need to be renovated. The building systems in these schools are at the end of their useful life and do not align with contemporary educational standards. Additionally, rural schools might not all have the conveniences of public utilities such as natural gas, water, sewer, and electricity. Thus, alternative fuels, disposal methods, generators, and water sources (which are more costly) may need to be used.

Conclusion

Changes to the current policies cannot wait, as rural communities do not have the fiscal and human capital to enact these repairs or new projects on their own. Maintenance of rural schools is critical not only since these outdated structures have gone decades without repairs, but also because the effect of insufficient maintenance can have serious results. This study is the first statewide policy recommendation of its kind that addresses the current state of schools in rural Pennsylvania. Four ways educational access can be attained at the rural level include: closely examine the current conditions of school buildings and create and organize an inventory assessment of facilities across Pennsylvania on an ongoing basis; alter the current purpose of under-utilized educational structures and shift the types of programs offered in some schools and districts to achieve maximum capacity; recognize and employ research to accommodate the space and technological needs students have as 21st century learners; and lastly, attend to the challenges that rural school buildings have in meeting learners' needs. By gathering major stakeholders and the departments of health, environmental quality, as well as members of the state legislature and school districts, inclusive discussions can take place that will allow for adequate access to education in the rural areas of Pennsylvania.

References

- Alaska Department of Education & Early Development. (2005). *A handbook to writing educational specifications*. Alaska EED. Retrieved from http://www.eed.state.ak.us/facilities/publications/EdSpec2005Edition.pdf
- California Department of General Services. (2006). *Report of the executive officer State allocation board meeting*. California DGS. Retrieved from http://www.documents.dgs.ca.gov/opsc/SAB_Agenda_Items/2006-01/Eligibility_Report.pdf
- Chan, T. C. (1998). School capacity update: An essential but often forgotten planning process. (ERIC Document Reproduction Service No. ED463639)
- DeJong, W. S., & Craig, J. (1999). Defining capacity. *Educational Facilities Planner*, 35(3), 18-22.
- Filardo, M., Bernstein, J., & Eisenbrey, R. (2011). *Creating jobs through FAST!: A proposed new infrastructure program to repair America's public schools*. Washington, DC: Economic Policy Institute.

- Filardo, M. (2008). *Good buildings, better schools: An economic stimulus opportunity with longterm benefits.* Briefing paper # 216. Washington, DC: Economic Policy Institute.
- Hunter, R. C. (2009). *The public school infrastructure problem: Deteriorating buildings and deferred maintenance*. Reston, VA: Association of School Business Officials International.
- Ilsley, P. S. (2002). The use of the moving average forecasting, linear trend forecasting, and exponential smoothing forecasting techniques in education. Dissertation Abstracts International: Section A. *The Sciences and Engineering*, *64*(06), 2013.
- Lawrence, B. K. (2001). *Effects of state policies on facilities planning and construction in rural districts.* Washington, DC: United States Government.
- Lawrence, B. K. (2003). Save a penny, lose a school: The real cost of deferred maintenance. Policy brief series on rural education. Washington, DC: Rural School and Community Trust.
- Montgomery, M. R. (2010). *Small rural school districts in Nebraska: A case study of challenges and solutions.* (Doctoral dissertation). University of Nebraska-Lincoln, Lincoln, NE.
- National Center for Education Statistics. (1999). Age of public schools based upon years since construction of the main instructional building(s), years since most recent major renovation, and functional age of the school, by school characteristics: 1999. Navigating resources for rural schools. Retrieved from
 - http://necs.ed.gov/surveys/ruraled/data/Age_of_Schools.asp
- National Center for Education Statistics. (2000). *Condition of America's school facilities*: 1999. Washington, DC: U.S. Government Printing Office.
- National Center for Education Statistics. (2002). *Digest of education statistics tables and figures*. Retrieved from http://nces.ed.gov/programs/digest/d02/dt419.asp
- National Center for Education Statistics. (2005). *Overcrowding*. Retrieved from http://nces.ed.gov/surveys/frss/publications/2000032/index.asp?sectionid=8
- Neblock, C. S. (1996). *The conceptualization, development, and evaluation of a national categorical enrollment projection model.* (Doctoral dissertation, Texas Tech University) Retrieved from http://repositories.tdl.org/ttu
 - ir/bitstream/handle/2346/18483/31295011192100.pdf?sequence=1
- North Carolina Department of Public Instruction. (2006). Elementary, middle, and high school typical space profile. North Carolina PDI. Retrieved from http://www.ncpublicschools.org/docs/src_communications/sample/district.pdf
- Pennsylvania Department of Education. (2003). *Academic standards for the arts and humanities*. Retrieved from http://www.pde.state.pa.us/stateboard_ed/lib/stateboard_ed/art.pdf
- Pennsylvania Department of Education. (2005). *The enrollment projection model*. Retrieved from http://www.education.state.pa.us/portal/server.pt/community/enrollment_projections/18805
- Peters, S. R. (1997). A teaching case for developing a facility utilization plan. Columbia University Teachers College, New York, NY.
- Sack, J. L. (2004). Costs climb on materials for schools. Education Week, 24(1), 1-24.
- Schaefer, S. M. (2010). Creating a program for transforming school facilities to become centers for their communities. *In Universities and Community Schools*, 8(1-2) 63-68.
- Sheets, M. E. (2009). *The relationship between the condition of school facilities and certain educational outcomes, particularly in rural public high schools in Texas*. (Doctoral dissertation). Texas Tech University: Lubbock, TX.

- Simpson, J. (2011). Finding funding: Making school improvements possible. *Council of Educational Facility Planners International*, 45(3), 38-41.
- Tanner, C. K., & Lackney, J. A. (2006). *Educational facilities planning: Leadership, architecture, and management*. Boston, MA: Pearson Education.
- Center for Rural Pennsylvania, The. (2005). *Trends in rural school enrollment: A 20-year perspective*. Retrieved from http://www.ruralpa.org/school_enrollment_projections.pdf
- Center for Rural Pennsylvania, The. (2012). *County profiles*. Retrieved from http://www.ruralpa2.org/county_profiles.cfm
- Watts Hull, J. (2009). *Protecting the investment: School facilities inspection and maintenance*. Atlanta, GA: The Southern Office of the Council of State Governments.

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