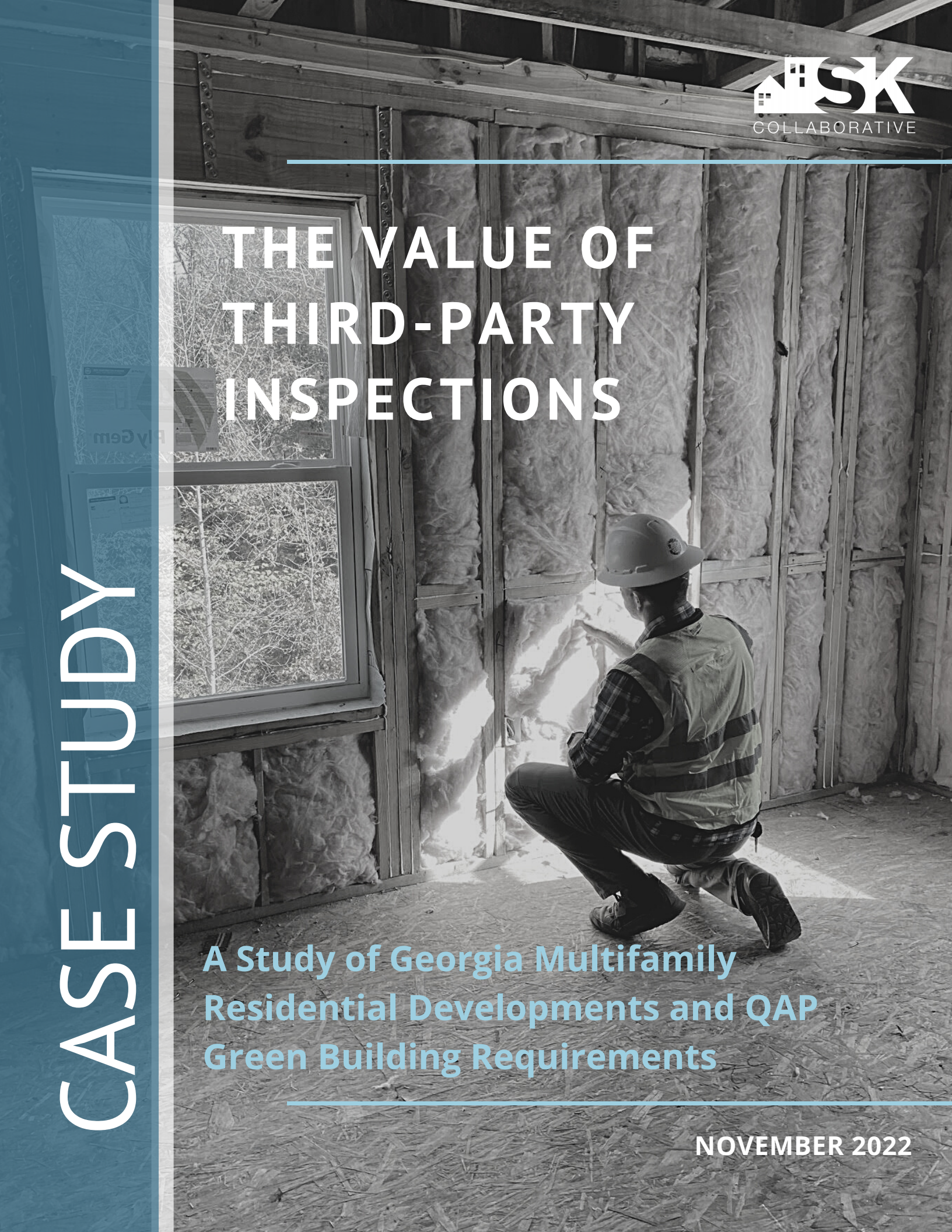
CASE STUDY



SK COLLABORATIVE

THE VALUE OF THIRD-PARTY INSPECTIONS

A Study of Georgia Multifamily Residential Developments and QAP Green Building Requirements

NOVEMBER 2022

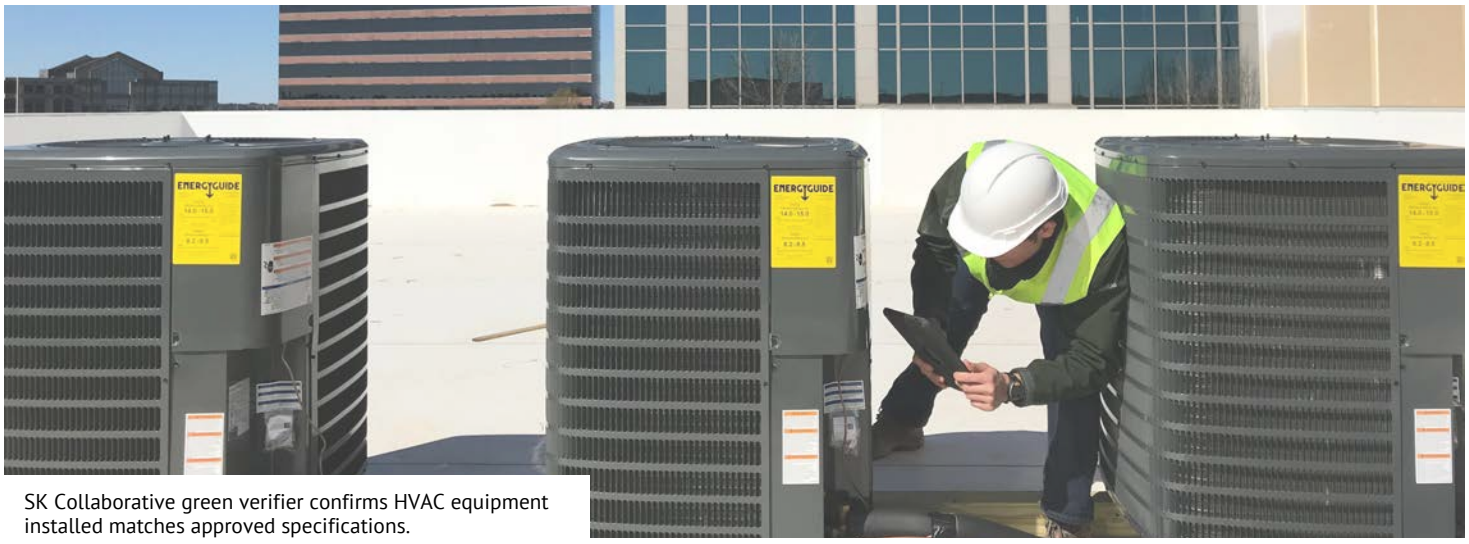
CONTENTS

INTRODUCTION

With the addition of green building certification as a Low Income Housing Tax Credit (LIHTC) requirement in a growing number of states, the question often comes up: Is third-party certification necessary, or is it enough for projects to self-verify program compliance?

Many builders and developers see green certification programs that require third-party inspections as a burden due to the time and expense of scheduling, potential delays, and corrections. Green building proponents and State Housing Finance Agencies (HFAs) that adopt the standards view these visual and performance inspections as essential in ensuring that sustainable construction practices are implemented as designed. But do they make a difference in the end result?

In this study, we review existing literature on third-party verification in the construction industry, the role of independent verifiers in the green building certification process, and firsthand field data to analyze the impact of third-party inspections. **Our data shows that third-party inspections are an effective tool for identifying construction deficiencies that would otherwise go uncorrected.**



SK Collaborative green verifier confirms HVAC equipment installed matches approved specifications.

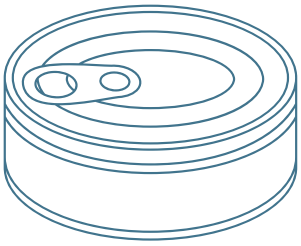
"IF DEVELOPERS ARE ALREADY BUILDING TO CODE, THEN WHAT VALUE DOES THIS THIRD-PARTY CERTIFICATION OFFER?"

CONTEXT

Green building programs were created to provide a healthier environment for both people and the planet by making homes more resource efficient and durable. They help improve construction quality while delivering higher investment returns for developers.[1,2,3] Third-party inspections are required by many green building certification programs.

Third-party certification helps assure that most of the work is being done correctly due to the independent nature of the verifier, who does not face internal company pressure to reduce costs. Certification also assures the project team that they are receiving what they paid for, and both the project and occupants benefit.[4] In the construction industry, rigorous green building standards and performance testing improve the quality of the built environment, reduce energy use, and increase long term durability.

THIRD-PARTY CERTIFICATION IN PUBLIC HEALTH AND CONSTRUCTION



Canned tuna is just one consumer product that you'll find at a grocery store claiming different certifications - some first-party and some third-party. If consumers are worried about mercury in their food, can they trust the company catching the fish to test its own product? Do they have the time or resources to evaluate the validity of the claims? These questions also apply to third-party certification vs. self-certification in green building.

Consumer products with a direct impact on health and/or environmental stewardship commonly use **third-party certification** - either voluntary or government mandated. State and local governments that adopt green certification into building code or tax credit incentives rely on these independent rating systems to verify that their standards are met. Multifamily developers who incorporate green certification (voluntarily or out of market-driven necessity) often choose third-party programs that are recognizable to prospective tenants — such as LEED, WELL, Fitwel, National Green Building Standard, EarthCraft, Enterprise Green Communities, and ENERGY STAR. A LEED-certified building or ENERGY STAR-rated dishwasher communicates a set of uniform, validated standards to the consumer, which instills confidence in the product. In fact, eighty-seven percent of Americans say green certification is important to them when purchasing a product.[5]

Many of the products used in the construction of a green home go through certifications and meet sustainability and health standards. For example, SCS Global Services certifies environmental, sustainability, food safety and quality performance claims, including materials used in many green construction projects. WaterSense-labeled products and services are certified to meet EPA criteria and use at least 20 percent less water, save energy, and perform as well as or better than regular models. The GreenGuard certification establishes thresholds for Volatile Organic Compounds (VOCs), such as benzene, ethylene glycol, formaldehyde, and other toxins in building materials and furnishings, allowing the constructed space to meet a healthy standard of indoor air quality where these products are installed. The Forest Stewardship Council certifies wood products, ensuring that these materials are sourced from responsibly managed forests.

Examples of building material and product certifications:

GREEN BUILDING CERTIFICATION AND THE ROLE OF THE VERIFIER

Green verifier involvement begins long before the first site inspection. The verifier is not only responsible for inspections, but also facilitating design review meetings with the development and construction teams, a construction kickoff meeting with all key contractors, and detailed plan and construction specification reviews before ever stepping foot on a project site. Verifiers often identify issues prior to inspection, such as problems with building materials, installation methods, and equipment efficiencies.

Mid-Construction Inspections

For new construction and substantial renovation projects, verifiers will perform a mid-construction inspection after insulation is installed, but before drywall is hung to verify insulation install quality, air sealing measures, framing, rough plumbing, electrical, HVAC, and other program requirements.

For moderate renovations, mid-renovation inspections are typically not required, although it is helpful to verify air sealing prior to the installation of cabinets, tubs, and showers.

SK Collaborative verifier performs air leakage testing on a townhome development under construction using a duct blaster.

SK Collaborative verifier inspects window flashing details and construction erosion control measures.

Final Inspections

The verifier returns to the project site for a final inspection after construction or renovation has been completed and units are ready for occupancy. All flooring, appliances, HVAC equipment, plumbing and electrical fixtures, and landscaping has been installed at this phase and the verifier checks all associated green criteria.

During the final inspection of Georgia QAP projects, the verifier also performs duct leakage and blower door testing to measure the airtightness of the building's envelope and HVAC system. They quantify the amount of air leakage after building improvements are made and confirm compliance with QAP targets.

The green verification process looks at the overall quality of construction, resulting in developments that meet or exceed building codes and product manufacturers' minimum installation requirements. Because we often find issues missed by code officials and installers, this adds an important layer of assurance that the building meets the expected levels of quality and performance.

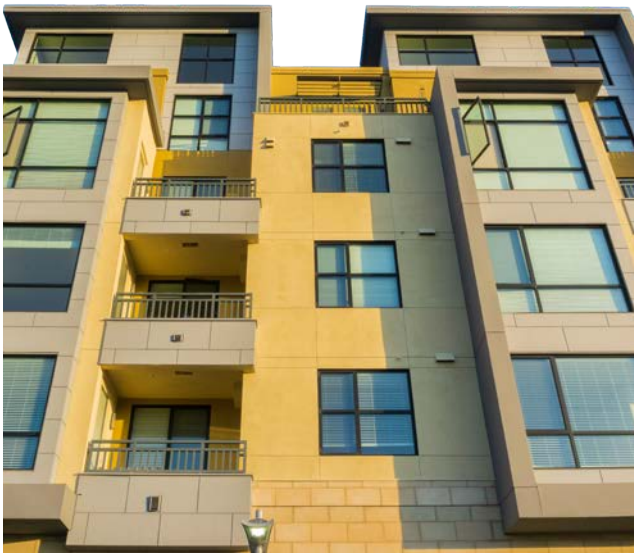
GREEN CERTIFICATION IN GEORGIA'S MULTIFAMILY AFFORDABLE HOUSING

Georgia is one of more than a dozen U.S. states and territories to require (not just incentivize) green building certification in its Qualified Allocation Plan (QAP). Green building certification, which includes third-party verification, provides an added layer of quality assurance. Georgia's QAP requires sustainable development standards because it recognizes third-party inspection as a critical step in ensuring high quality, holistic affordable housing for low-income Georgia residents.

Since 2019, Georgia has required green building certification for all Low Income Housing Tax Credit (LIHTC) financed projects — both new and rehab — under one of the following programs:

- EarthCraft Multifamily (ECMF)
- EarthCraft Sustainable Preservation (ECSP)
- Enterprise Green Communities (EGC)
- Green Globes for Multifamily Buildings (added in 2022)
- LEED for Homes (LEED H)
- National Green Building Standard (NGBS)

Before 2019, green certification was an optional point item under the QAP. Applicants could opt to certify or not, but were still subject to other QAP sustainability requirements, such as building materials, insulation, and air leakage testing, which are verified through third- party inspection.

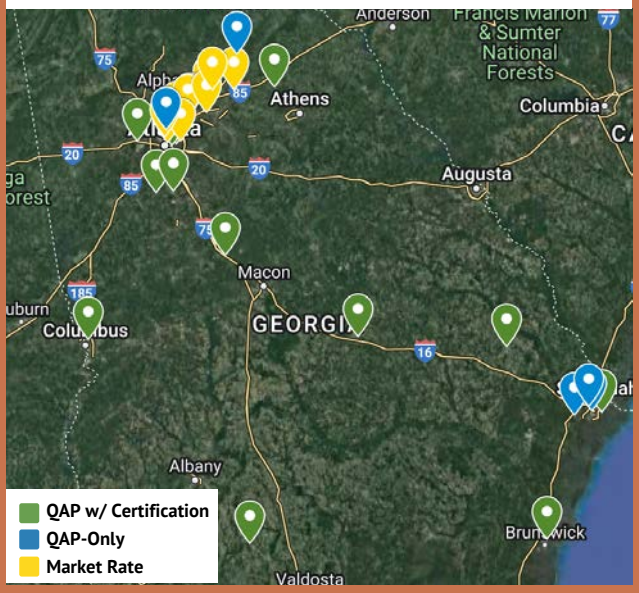


Why are states like Georgia embracing green building practices in their QAPs? A major driver is the prevention of low-quality affordable housing that may lead to health complications and financial issues for residents who are already vulnerable.

In addition to improving physical health (Appendix B), green homes can significantly reduce the burden of high utility costs that often make "affordable" homes not so affordable.[6] When homes are not energy-efficient, higher energy bills can create an economic barrier to accessing healthcare for those who are already vulnerable to illness. High burden of utility costs disproportionately affects low-income Black, Hispanic, and Native American populations, decreasing economic mobility.[7] Additionally, both the inability to pay utility bills and a lack of thermal comfort have been found to independently raise levels of stress - damaging occupants' mental and physical health.[8]

RESEARCH OVERVIEW

Map: Distribution of Georgia Projects Sampled



We reviewed a sample of 30 multifamily developments in Georgia, recording and categorizing issues that SK Collaborative observed in the field.

Among this sample, 20 were new construction and renovation projects financed with LIHTC awards under Georgia's 2016-2019 QAPs. Fifteen of the QAP projects pursued NGBS Green, EarthCraft Multifamily, or Enterprise Green Communities certification. The other five LIHTC projects elected to only meet the state QAP requirements for duct and envelope tightness and other required sustainability items.

For comparison, we also sampled 10 market rate developments pursuing EarthCraft Multifamily or NGBS certification (without air leakage testing).

METHODOLOGY

All projects — those pursuing green certification or just the core pre-2019 QAP sustainability points ("QAP-only") — included third-party inspection mid-construction (immediately following insulation) and again when construction was substantially complete. While mid-construction inspections were optional for QAP-only projects, all of the reviewed projects included them.

For this data review, we analyzed photographs and notes from the original inspection reports for the sampled projects. We then compared this data to overall deficiency rates during a building's first mid-construction and final construction inspections.

Deficiencies were recorded by type, not quantity. For example, we counted wall insulation deficiencies as one item, even though there may have been multiple wall insulation-related problems in a single project. A project with four deficiencies noted had four observed types of code, certification, and/or QAP compliance issues, such as: not sealing penetrations in walls, evidence of microbial growth (mold), insufficient insulation, or incorrect rating/missing HVAC air filters. Even if the verifier found several holes in the wall, these were all counted as one deficiency for the purposes of this analysis.

We have included the anonymized raw data collected in Appendix A, which is separated by project type (QAP with Certification, QAP-Only, and Market Rate). This data was used as the basis of the Data Analysis section, which we in turn interpreted to draw conclusions on the effectiveness of the additional consulting and verification provided by the third-party inspections.

ASSUMPTIONS AND LIMITATIONS

Green building certification and verifer involvement in a project begins before the first inspection. Issues that SK Collaborative identified prior to inspection, either through construction document review or pre-construction project team meetings, were not included in our analysis.

Builders and trade contractors are usually present during the inspection, enabling them to make corrections identified during site visits. When issues are remediated on site, they often do not show up on the inspection reports. Because these avoided deficiencies were not captured in the reports, they are also not reflected in the data collection of this study.

We attempted to separate code-related issues from green building certification-specific deficiencies, but this is complicated by several factors. Code officials do not enforce the energy code consistently, and projects may fall under either the residential or commercial building provisions.

Insulation and air sealing issues were grouped as appropriate, so the actual number of deficiencies or "findings" were often significantly higher than the amount shown. For example, an apartment unit may have needed ceiling insulation corrections in multiple locations, but all of these occurrences were recorded as one deficiency type.

For green-certified projects, we included deficiencies for optional items that were being pursued and then ultimately had to be dropped. For example, a handful of projects initially pursued points for ENERGY STAR clothes washers, but standard efficiency appliances were installed. Ultimately, these points were removed from the overall project score without impacting the green certification. However, they were still counted as deficiencies because the project had originally committed to implementing them and would have received points for them had third-party verification not occurred.

Additionally, we only included the first instance of a particular issue even if multiple reinspections and corrections were required to resolve the deficiency. We reviewed inspection reports for the first mid-construction inspection and first final inspection for each of the sampled projects. Depending on project size, some developments may have several inspections at both mid- and final construction. This case study does not account for repeat deficiencies during subsequent inspections. For example, if there were the same (or new) envelope and duct sealing errors in the second mid-construction inspection for a project, those additional deficiencies are not counted in the mid-construction data totals.

Blower door equipment, ready to measure the building envelope air leakage rate.

SK verifier assesses air sealing measures around windows.

TYPES OF DEFICIENCIES DOCUMENTED

Green building deficiencies reflect specific program requirements and optional criteria. For example: poorly installed duct work (excessive bends and crimps), non-specified HVAC filter installed, no rodent or pest screens over ventilation openings, missing dampers on bath exhaust duct work, inadequate construction site protection (erosion control, tree preservation), window flashing, etc.

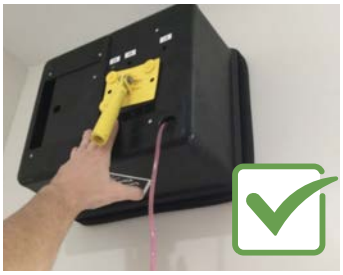
Code deficiencies include issues that overlap with energy, fire, mechanical, and building codes. Georgia requires blower door testing for residential buildings three stories and under as well as air sealing measures. We categorized air sealing and duct sealing deficiencies as code items during data collection. The purpose of the inspections was not to verify code compliance; however, breaking out green certification/QAP issues that also fell under code requirements was valuable for analysis. These deficiencies were not double counted.

QAP compliance deficiencies apply to pre-2019 QAP projects that elected not to certify under a green building program, but were still subject to a short list of prescriptive sustainability measures, such as ENERGY STAR-qualified bath exhaust fans.

Poorly maintained silt fencing around the construction site perimeter.

Kitchen faucet shows correct low flow rate for QAP compliance.

Poorly installed fiberglass batts.



An inspector measures the air flow of an in-wall bath exhaust fan.

Compressed insulation leads to uneven distribution and R-value effectiveness.

Unsealed penetrations through the top plate.

Visible gaps between wood frame and window lead to air leakage and water intrusion.

Lack of a rigid air barrier enables insulation to spill over from insulated areas (above units) to uninsulated areas (over breezeways).

DATA ANALYSIS

Table 1. Average Number of Deficiencies Per Building (by Project Type)

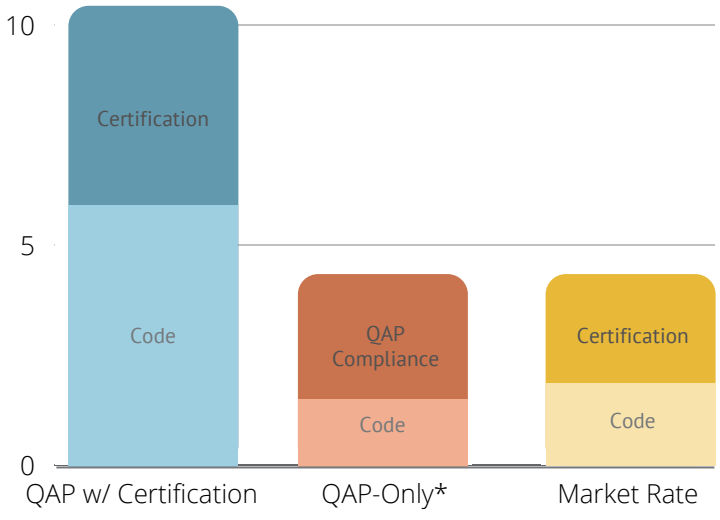
Project Type	Code-Related	Certification	QAP Compliance	Total
QAP w/ Certification	5.9	4.6	N/A*	10.5
QAP Only - No Certification	1.4	N/A	2.8	4.2
Market Rate w/ Certification	1.8	2.6	N/A*	4.4

Notes:

- All deficiencies were corrected as a part of the inspection process.
- Deficiency averages include mid- and final inspection combined totals for each project.
- "Number of deficiencies" represents number of types of deficiencies, not the quantity of those deficiencies noted in a project (e.g. improper air sealing, insulation, flashing, etc).

*Duct and Envelope Tightness (DET) testing issues were categorized under Code-Related (see "Types of Deficiencies Documented" section). Other prescriptive QAP threshold items were captured under Certification deficiencies.

Figure 1. Average Number of Deficiencies Per Building (by Project Type)



QAP w/ Certification:
LIHTC projects that opted for green building certification (in addition to other QAP sustainability requirements).

QAP-Only:
LIHTC projects that opted NOT to pursue certification, instead seeking compliance only with mandatory QAP sustainability threshold criteria.

Market Rate:
Market rate (not LIHTC-) multifamily developments pursuing green building certification.

Notes:
*Includes air and duct sealing deficiencies only (certification N/A).

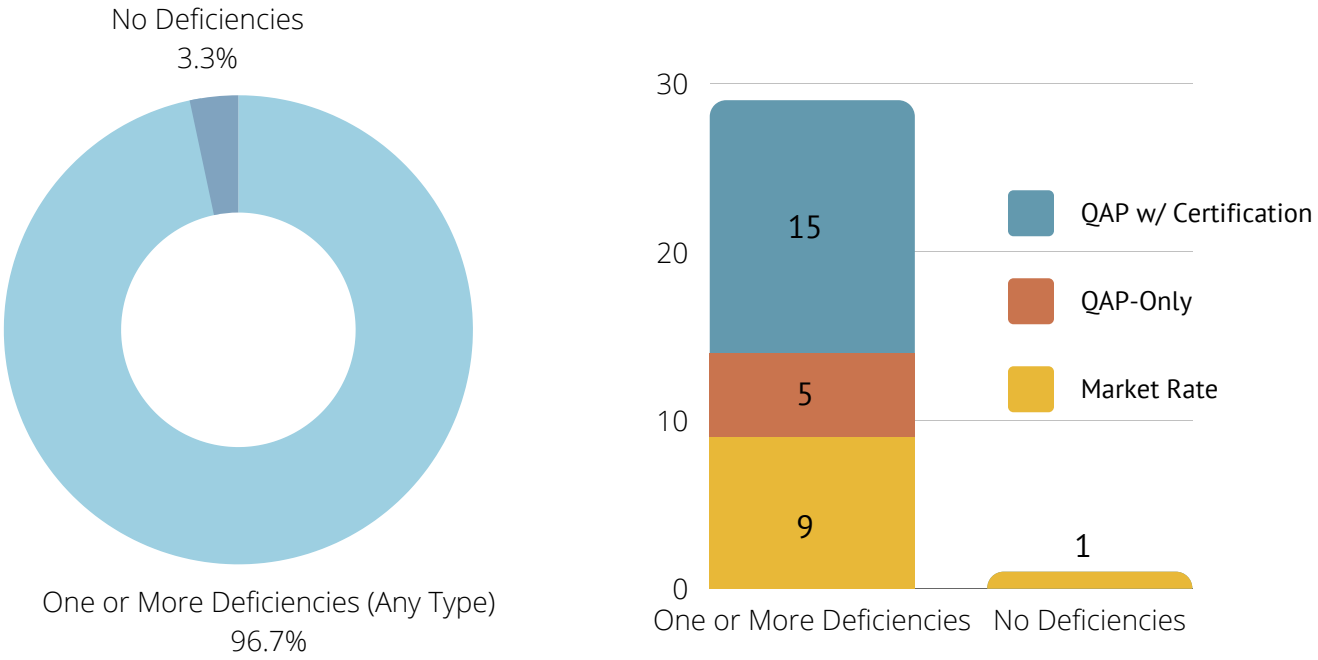
DATA ANALYSIS (CONTINUED)

Table 2. Total Number of Deficiencies (by Phase and Project Type)

Mid-Construction			Final		
QAP w/ Certification	QAP-Only	Market Rate w/ Certification	QAP w/ Certification	QAP-Only	Market Rate w/ Certification
89	12	34	69	9	10
Total Mid-Construction Inspection Deficiencies: 135			**Total Final Inspection Deficiencies: 88**		

Note: Averages in the table above are based on combined totals of deficiency type (code, certification, QAP compliance) for each project.

Figure 2. Projects with Building Deficiencies (Percent and Total)



Note: Includes deficiencies across inspection phase (mid-construction or final) and deficiency type (code, certification, or QAP compliance) for all project types.

RESEARCH FINDINGS

1. A higher number of issues on average were found during inspections for QAP projects seeking green certification than with those only meeting QAP requirements. This is not surprising given the additional construction requirements and heightened project scrutiny.

2. Market-rate buildings seeking green certification had the lowest average number of issues. However, it's not as simple as "market rate buildings are better constructed." The market rate buildings tend to be taller and did not pursue optional performance testing under the NGBS program. Therefore, the issues related to optional testing were not evaluated.

3. Of the 30 reviewed projects, 29 had at least one construction deficiency. 100% of QAP projects had at least two (and as many as 20) types of deficiencies.

Across all of the 30 projects we analyzed, there was only one project (market rate) that was completely issue-free between both inspection phases (Figure 2). 100% of QAP projects (both certification and QAP-only) had at least two types of deficiencies and as many as 20. Between all three project types, we counted 135 total deficiencies at mid-construction and 88 total deficiencies during final inspection. This is somewhat surprising because every project team knew in advance that there would be third-party verification — and yet there were still many problems that would have otherwise gone uncorrected if not called out via inspection.

QAP projects seeking green certification had an average of 10.5 deficiencies per building (certification and code), QAP-only projects had an average of 4.2 deficiencies per building (QAP compliance and code), and market rate projects had an average of 4.4 deficiencies per building (certification and code). Since the green certification process is meant to hold buildings to a higher quality standard through more rigorous inspection of weather barriers, HVAC filters, air sealing, insulation, etc., a higher occurrence of identified deficiencies is not surprising.

Several market rate projects had zero deficiencies during final inspection (but not mid-construction), but we attribute this to the fact that all of the market rate projects were mid- or high-rise and therefore exempt from post-construction duct and envelope leakage testing under Georgia code. Almost every QAP project (both certification-seeking and QAP-only) had issues at both mid- and final inspections, and all them had deficiencies during at least one inspection.

Many of the issues identified by the verifier inspections were also building code deficiencies that had been overlooked by local officials, such as missing or incomplete envelope air sealing and poorly installed or completely missing insulation. These items are required by International Building Code, International Residential Code for One- and Two-Family Dwellings, International Fire Code, International Mechanical Code, and International Energy Conservation Code. Some projects had incomplete duct sealing and excessive duct leakage. Projects were also frequently in violation of Georgia sediment and erosion control requirements, which are also requirements in the green building programs. Green building program-specific deficiencies included poorly installed HVAC ductwork (excessive bends and crimps), non-specified HVAC filter installed, no rodent or pest screens over ventilation openings, and missing dampers on bath exhaust ductwork.

CONCLUSION

Projects pursuing green building certification had more deficiencies, but that was expected because there were significantly more compliance items to be inspected than for the QAP-only projects. All projects struggled with basic energy code requirements like properly installed insulation and air sealing. **If these deficiencies had not been identified and then corrected, residents would likely have experienced higher utility bills in less comfortable homes.** Property management and owners would likely have faced maintenance problems and resident complaints. However, because inspections were required, all of these issues were identified and addressed.

Every single QAP project and all but one market-rate project had one or more deficiencies. Because our data set does not include issues identified during construction document review or those that were remedied during the inspection, we expect that the total number of deficiencies that would have occurred without verifier involvement is actually significantly higher than the numbers reported here.

All the development teams for projects included in this sample were aware that third-party inspections would take place, yet the verifiers still identified numerous issues that required remediation. For all of these projects, third-party verification was a critical piece in finding and resolving issues before project completion, thereby avoiding long-term problems that would have had a direct impact on residents. The bottom line: **Simply requiring projects to be built to a given standard does not guarantee adequate results.**

Future research could benefit from a larger sample of both QAP and market rate projects. Evaluating projects over a greater span of time could also highlight trends over time. We also recommend including Georgia market rate buildings that have optional testing as a comparative reference point to the ones we studied, which did not include testing.

As a green verifier company, SK Collaborative sees the value and importance of third-party inspections - it's what we do. This case study backs up that claim and gives a detailed analysis of just how important inspections by industry experts are in delivering a building that protects its owner's investment as well as the health, well-being, and wallets of its occupants.

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APPENDIX A: DATA COLLECTION FROM FIELD REPORTS

*Note that the descriptions in the following tables are largely taken from SK Collaborative inspection reports. There is some variation in language based on multiple verifiers working in the field.

QAP PROJECTS PURSUING CERTIFICATION

			Mid-Construction Inspection			Final Inspection		
QAP Year	Construction Type	Certification Program	Code Issues	Certification Issues	Inspection Notes	Code Issues	Certification Issues	Inspection Notes
2016	New Construction	EGC, ESv3	7	3	Poor insulation install quality and numerous air sealing issues.	0	10	Failed envelope leakage, duct leakage, exhaust flow testing, and ventilation testing. Filters not MERV rated, no air seal between drywall and top plate, no door sweeps, missing attic insulation baffles, attic access doors not gasketed or insulated, no rodent screens, and numerous drywall air sealing issues.
2016	New Construction	NGBS	8	6	Air sealing needed at exterior sheathing, bottom plates framing to slab, windows and doors, chases on exterior walls, tub drains, and rim joists. Wet batt insulation must be replaced. Poor insulation quality. Incomplete thermal envelope on top floor.	1	3	Mechanical closet penetrations. Missing occupancy sensors in common areas and non-ES clothes washers. Failed pressure balancing.
2017	New Construction	EGC, ESv3	5	2	Air sealing needed at top plates, knee walls, rim joists, around doors and beneath stairs on exterior walls. Insulation in double walls missing. Many other issues avoided by numerous walk throughs before inspection.	3	6	Failures at attic insulation, attic access door insulation, and weather stripping. Air sealing at envelope drywall. Duct sealing. Failed ventilation flow, exhaust flow, and pressure balance testing. High MERV filters must be installed.
2017	Renovation	EGC, ESv3	1	1	Drywall air sealing and ineffective duct sealing. All other issues avoided by numerous walk throughs before and during the renovation.	0	1	Air sealing needed in mechanical closets. Visual inspection of rehab buildings otherwise limited under EGC. These visits were primarily to test duct and envelope leakage for QAP compliance.
2016	New Construction	ECMF	1	1	Plumbing penetrations not sealed. Rim joist not sealed.	0	7	Rodent screens missing and filters not MERV rated. Duct and envelope testing failed. Drywall penetrations, dampers on exhaust pipes, air sealing in mechanical closets.
2019	Renovation	NGBS	7	2	Windows not sealed at rough opening, plumbing not sealed to drywall, exhaust fans not sealed to drywall, mechanical closet penetrations not sealed, washer/dryer boxes not sealed, drywall behind cabinets not sealed, air handler penetrations not sealed, boots not protected"", pan flashing not visible""	2	2	Bath fans not sealed to drywall, mechanical closets not sealed ... gutters did not discharge 5 feet from foundation walls, no humidistat or timer installed on bath fans (QAP requirement and optional NGBS)
2017	New Construction	EGC, ESv3	2	2	Fresh air intakes were not air sealed or weather sealed". OCSF insulation required touch up at limited areas disturbed due to sequencing of some electrical install", concrete basement walls against grade not insulated.	0	5	No filters installed, ... HVAC model numbers and ventilation strategy did not match ESv3 design forms, ventilation controls had to be adjusted, bath fans failed flow testing,
2019	Renovation	NGBS	1	1	Mechanical closet air sealing, humidistat or timer not installed for bath fans (required for QAP, optional for NGBS)	8	0	Air Sealing: sealing all mechanical closet penetrations, sealing all plumbing penetrations, sealing all supply boots to drywall, sealing all exhaust fans to drywall. Additionally, we would recommend sealing the perimeters of outlet boxes and electrical panels. Duct Sealing: sealing all seams and connections WITH MASTIC, sealing all connections between the return plenum and air handler, completely sealing all exposed duct work.
2019	Renovation	NGBS	5	1	Boots not sealed to drywall, bath fans not sealed to drywall, mechanical closets not sealed, plumbing and electrical penetrations not sealed ... bath fans not EnergyStar,	0	0	All other inspection items and testing went very smoothly.
2017	New Construction	EGC, ESv3	7	3	Air sealing: Issues found with window and door air sealing, exterior wall penetrations, chases, sealing bottom plates to slab, etc. Insulation: Rim joist insulation completely missing" in many locations, did not meet grade 2 requirements where installed, missing insulation behind blocking and at random empty cavities" throughout the building, missing attic insulation in end units". HVAC: ducts sealed on outside of insulation jacket, not on inside. Exhaust ducts undersized and installed with excessive turns.	1	2	1. Ceiling insulation need a rigid air barrier (baffle) to separate insulated and uninsulated areas. 2. Air filters need to be MERV 6 or better. 3. Duct leakage was an issue throughout the final test out phase, due to very complicated return plenums and exterior mechanical closets.
2019	New Construction	NGBS	4	1	Some evidence of microbial growth + some HVAC openings not covered + Grade II wall insulation discrepancies. The following applies to all exterior walls to include the band. Shaft wall insulation and attic insulation platform areas also required attention.	0	2	Kickout flashing, kitchen aerators did not match model
2019	Renovation	NGBS	5	0	Boots not sealed to drywall, significant holes behind cabinets, other holes in drywall for lighting and for plumbing, mechanical closets not sealed	5	0	Sealing of plenums to new air handler, mechanical closet air sealing, bath fan air sealing, plumbing air sealing, combustion safety issue
2019	Renovation	NGBS	3	1	Window air sealing, window flashing (green bldg req), mechanical closet air sealing, duct sealing at air handler	3	0	Mechanical closet air sealing, bath fan air sealing, duct sealing
2019	Renovation	NGBS	5	0	Mechanical closet air sealing, duct sealing at return plenums, bath fans air sealing, plumbing penetration air sealing, boot to drywall air sealing,	3	0	Plumbing penetrations, duct boot sealing, mechanical closet air sealing,
2019	New Construction	EGC, ESv3	2	2	Air sealing of rim between unit and exterior mechanical closet, air sealing of exterior electrical box penetrations, elimination of transfer grilles and had to do other strategies for pressure balancing, covering of pre-rock and exterior continuous insulation without inspection	0	5	1. Static pressure testing 2. Total duct leakage testing 3. Continuous bath fan unit ventilation flow testing 4. Intermittent bath fan local exhaust flow testing 5. MERV 6 filters

	Energy Code	Certification
Total Mid-Construction Issues:	63	26
Average:	4.2	1.7

	Energy Code	Certification
Total Final Inspection Issues:	26	43
Average:	1.7	2.9

QAP-ONLY: PROJECTS NOT PURSUING CERTIFICATION

			Mid-Construction Inspection			Final Inspection		
Project ID	QAP Year	Construction Type	Code Issues	QAP Compliance Issues	Mid-Construction Notes	Code Issues	QAP Compliance Issues	Final Inspection Notes
SK6	2018	Renovation	N/A	N/A	Not contracted for mid-construction inspections. 2 pre-renovation testing visits. 1 more visit at start of work to review scope.	N/A	2	Mechanical closet and drywall air sealing missing.
SK7	2018	Renovation	N/A	7	Contracted for mid-construction inspections. Kitchen exhaust ducts not sealed to drywall. Duct boots not sealed to drywall. Top and bottom plate penetrations unsealed. Multiple plumbing penetrations through drywall need sealing. Relocated duct needs sealing. Mechanical closet needs air sealing.	N/A	2	Need to remove high/low vents and air seal mechanical closet.
SK8	2017	New Construction	2	0	Need to correct duct take off air sealing and unit envelope air sealing	2	0	Duct and envelope sealing incomplete.
SK9	2017	Renovation	N/A	N/A	Mid-construction testing of 3 units. No thorough inspection included.	N/A	3	Corrections needed for leakage around PTACs, plumbing penetrations, and attic access points.
SK10	2017	New Construction	3	0	Failures at structural penetration air sealing, bottom plate air sealing, exterior wall air sealing.	0	0	Consistently passed test out

	Energy Code	Certification
Total Mid-Construction Issues:	5	7
Average:	2.5	2.3

	Energy Code	Certification
Total Final Inspection Issues:	2	7
Average:	1.0	1.4

MARKET RATE: PURSUING CERTIFICATION

			Mid-Construction Inspection			Final Inspection		
Project ID	Construction Type	Certification Program	Code Issues	Certification Issues	Mid-Construction Notes	Code Issues	Certification Issues	Final Inspection Notes
SK21	New Construction	NGBS, no testing	1	2	Band air sealing, band insulation quality, supply boots not covered.	0	0	None found
SK22	New Construction	NGBS, no testing	1	2	Batts compressed in narrow cavities, batts not split around obstructions, windows and doors not air sealed in some locations	0	0	None found
SK23	New Construction	NGBS, no testing	0	0	None found	0	0	None found
SK24	New Construction	NGBS, no testing	0	2	Rough duct testing failures and covering HVAC openings	0	0	None found
SK25	New Construction	NGBS, no testing	3	0	Air sealing of bands, air sealing of chases, missing insulation	0	0	None found
SK26	New Construction and Renovation	NGBS, no testing	3	5	Insulation of attic knee walls, missing attic insulation baffles, air sealing inside fireplace chase, insulating gap at parking garage walls, water leaks, protection of HVAC openings, general insulation quality, erosion and sediment controls	0	0	None found
SK27	New Construction	ECMF	6	1	Balcony flashing, band air sealing, exterior wall air sealing, window and door air sealing, chase air sealing, bottom plates to slab, attic insulation baffles	2	3	Drywall air sealing, weather stripping, plants 2 feet from foundation walls at maturity, no drain pans under washers and water heaters, no attic insulation rulers
SK28	New Construction	NGBS, no testing	0	0	None found	0	3	Downspouts did not discharge minimum 5 feet from foundation walls, clothes washers not EnergyStar, screens not installed on all windows
SK29	New Construction	NGBS, no testing	1	4	Incomplete fill of insulation in exterior wall cavities, splitting around obstructions, filling wider metal framed cavities, insulating narrow cavities without compression, replacing wet insulation	0	0	None found
SK30	New Construction	NGBS, no testing	1	2	Building shaft insulation, protection of HVAC openings, air sealing of exterior walls inside chases,	0	2	Non-EnergyStar clothes washers, standard flow shower heads

	Energy Code	Certification
Total Mid-Construction Issues:	**16**	**18**
Average:	**1.6**	**1.8**

	Energy Code	Certification
Total Final Inspection Issues:	**2**	**8**
Average:	**0.2**	**0.8**

APPENDIX A

APPENDIX B: HEALTH BENEFITS OF GREEN BUILDING

Lower socioeconomic groups are disproportionately affected by low-quality housing that can have water intrusion, pests, mold, and high utility costs. This not only has negative impacts on the comfort of the residents, but can also lead to poor health and economic distress. Those who are lower income tend to have higher rates of asthma and other respiratory issues, while also facing more challenges when it comes to obtaining care.[9]

Rates of asthma and lower respiratory problems have been shown to decrease in homes that had energy-efficiency related certifications, with lower levels of airborne mold, particulate matter, VOCs, and radon found in treated homes.[10] As articulated in the table below, there are numerous impacts -- both direct and indirect -- that energy efficient construction makes on occupant health and well-being. This is because home performance programs, like green building certifications, often do more than just making a home energy efficient. Tight homes often require better ventilation that improves air quality, and reduces associated pests, mold, and structural deficiencies.

Table 4.1 Overview of direct and indirect impacts of improved energy efficiency on health and well-being

Energy efficiency measures	Impacts associated with energy efficiency measures		Potential health outcomes - direct		Potential health outcomes - indirect	
Insulation	Warmer, drier, indoor environment	Comfortable temperature	Reduced deaths from cold and hot spells^{+++}	Reduced excess (winter and summer) mortality^{+++}	Reduced absenteeism from school^{++}	
Draught-proofing, pipe lagging, lighting			Reduced symptoms of respiratory disease: asthma, lung cancer, Chronic Obstructive Pulmonary Disease^{+++}		Improved academic performance^{+}	
Extractor fans	Well ventilated/ good air quality	Reduced damp*	Reduced symptoms of cardiovascular disease (e.g. angina, atrial fibralation, risk of stroke)$^{+++}$	Reduced hospitalisation^{++}	Reduced absenteeism from work^{++}	
		Reduced mould*	Reduced depression^{++}		Increased productivity^{+}	
			Reduced arthritis and rheumatism^{++}		Increased earning power^{++}	
			Reduced injuries and death^{+}			
Efficient, effective heating systems		Comfortable temperature	Reduced allergies^{++}	Reduced pharmaceuticals $^{+}$		Reduced public and private spending on health
		Reduction of gas and particulates* $^{+++}$	Reduced respiratory disease: asthma, lung cancer, Chronic Obstructive Pulmonary Disease^{+++}	Reduced hospitalisation^{+++}		
			Reduced injuries and death^{++}			
		Increased usable living space	Reduced stress^{++}		Increased sociability^{+}	
			Reduced close contact infectious diseases^{++}		Increased space for homework^{+}	
Efficient and effective cooking/ refrigeration systems		Reduced gas and particulates*	Reduced injuries and death^{+}			
		Improved fitness for purpose (i.e. better refrigeration and cooking facilities)	Improved nutritional status^{++}			
	Reduced energy bills/ reduced exposure to energy price fluctuations	Increased sense of control^{+}	Reduced stress and despression^{++}			
		Less fear of falling into debt^{+}				
		More disposable income	Increased purchase of food and other essentials^{+}		Improved nutrition^{++}	
					Increased access to preventative health care^{+}	

Notes: This graphic illustrates the impact pathways from energy efficiency measures to three major impacts. Colour coding established in the impacts column corresponds with the various outcomes a measure could generate for health. This simplified flow diagram does not depict all of the complex interrelationships related to energy efficiency and health and well-being outcomes.
$^{+}$, $^{++}$, or $^{+++}$ symbol indicates the strength of the evidential basis, with $^{+}$ being lowest and $^{+++}$ being highest.
* Caution: Sealing homes without adequate ventilation can cause unintended negative consequences for health.
Source: Unless otherwise noted, all material in figures and tables in this chapter derives from IEA data and analysis.

Capturing the Multiple Benefits of Energy Efficiency report (2015). International Energy Agency.