

Evaluation of a Low-Income Energy Efficiency Program

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ABSTRACT

The NJ Comfort Partners Program provides no-cost energy efficiency services to low-income utility customers throughout the state. This program is a good example of a long-standing low-income efficiency program that has evolved and improved over the past decade by working to incorporate state of the art weatherization procedures and techniques and evaluation recommendations. The program is unique because electric and gas utilities across the state have collaborated to provide joint service delivery to eligible customers.

A comprehensive evaluation of this program is assessing how program procedures have been implemented and the effectiveness of program treatments. The research includes analysis of program data, usage and payment impact analysis, customer surveys, on-site observation of service delivery, and post-completion inspections. The research will also include an analysis of how program protocols for energy savings relate to the actual savings achieved in the program. Because the evaluation includes on-site research, information on the quality and comprehensiveness of treatments will be factored into this analysis. Recommendations will be also be made for modifying the protocols to provide for more accurate predictions of energy savings.

Objectives

The objectives of the study were to document the following:

- The extent to which the program achieves its goals.
- Opportunities available for increased effectiveness or reduced costs.
- Specific program changes to accomplish these improvements.

Study Overview

The evaluation work scope had five key topic areas with several subtasks.

1. Data Tracking System – This research identified the program’s information needs; reviewed the content and quality of information in the current tracking system; assessed the sufficiency, accuracy, and efficiency of the system; determined how the system is used by program partners to effectively manage the program; and developed recommendations for enhancements to and use of the system.. Moving forward, the research will verify protocol savings calculations that are contained in the database.
2. Process – The process research included materials review, needs assessment, utility interviews, contractor interviews, on-site observations, and inspections of completed jobs.

- Procedures and Materials Review: We reviewed and assessed the Comfort Partners' procedures manual, and additional materials including staff training, marketing, and reporting.
 - Needs Assessment: We analyzed American Community Survey data to provide information on the characteristics and needs of NJ households that are eligible for the program.
 - Utility Interviews: We conducted in-depth interviews with managers and staff at the six participating utilities to develop a complete understanding of program design and implementation, reviewed utility decision making for consistency, and identified barriers to program effectiveness.
 - Contractor Interviews: We conducted in-depth interviews with managers and staff at the five prime service delivery contractors. The interviews included discussion of staff experience, training and certification procedures, performance tracking, and recommendations for program improvement. We spent a day on site at each prime service delivery contractor to assess program management and operations.
 - On-site Observations: We conducted on-site observations of audits, measure installation, and final inspections using a detailed data collection system that assessed whether key steps and tests were conducted, and rated the quality and comprehensiveness of the services.
 - Inspections of Completed Jobs: We are conducting inspections of completed work to provide a statistically reliable analysis of job quality and comprehensiveness.
3. Affordability – The research assessed customers' views on the program's impact on affordability and will measure this impact through the customer billing analysis.
- Customer Survey: We conducted a survey with program participants to assess program understanding, impact, and satisfaction.
 - Affordability and Payment Impact Analysis: We are analyzing customer billing and payment data to estimate the program's impact on energy bills, subsidies, energy burden, and energy bill payment.
4. Impact – The impact research includes analysis of the data obtained from the program's data tracking system, computation of savings estimates, estimates of the impacts of the program through analysis of customers' energy usage data, and analysis of the realization of expected savings.
- Comfort Partners Program Data Analysis: We analyzed the tracking system data to characterize the program, including customer and housing characteristics, measure installation penetration and costs, and inclusion of health and safety measures.
 - Engineering Impact Estimates: We are using data on measures installed to estimate the expected impacts of service delivery.
 - Usage Impact Analysis: We obtained energy usage data from the six utilities and are conducting weather normalized, comparison group adjusted analysis of the energy impacts of the program on natural gas and electricity consumption.
 - Savings Realization Rates: We will compare predicted to actual savings and compute the savings realization rates.

5. Energy Saving Protocols – We will review and verify the appropriateness of existing energy saving protocols, compare those estimates to our engineering impact estimates, and recommend changes that could improve the accuracy of the savings estimates based on findings from the impact analysis.

Program Resources

The NJ Comfort Partners Program has developed and refined tools and guidelines for managing and implementing the program. This section focuses on the data tracking system and the program procedures.

The following research activities were conducted to provide an understanding of the content and capabilities of the data tracking system, how the system is used, and planned and desired system enhancements.

1. Tracking System Data Analysis – We downloaded the data in the tracking system, reviewed the included data fields included, and analyzed those data.
2. User Access to Tracking System – We reviewed the information, capabilities, and reports available to utilities, contractors, and the inspector.
3. Utility Interviews – We discussed how utilities use the tracking system, reports that are utilized to manage the program, and how the system can be improved.
4. Contractor Interviews – We discussed how the Comfort Partners tracking system is used, use of additional internal data systems and why those systems are needed, and recommendations for improvements to the CP tracking system.
5. Contractor On-Sites – We observed how contractors use the program tracking system and their own tracking systems, and obtained copies of reports used to manage the program.

The Comfort Partners Tracking System provides important data to manage and implement the program, to evaluate the program, and to determine how the program can be improved. Data that are available to program managers and contractors are much more comprehensive than have been seen in many other programs. Recommendations for improving the system to provide for more efficient program management and operations, and to allow for a more comprehensive evaluation are as follows.

1. Management – Many canned reports in the CP tracking system allow the utilities to obtain a list of customers who meet certain criteria. Additional reports that provide summary statistics could provide useful information to help manage the program. For example, the following types of reports, by contractor and utility over specified time periods, may be useful for utilities and/or contractors.
 - Number of jobs audited, installed, and completed
 - Percent of jobs deferred or partial due to service delivery barriers
 - Average job cost
 - Percent of jobs that have certain key measures installed
 - Average measure cost for key measures installed

For the shorter term, the utilities and contractors should develop a list of reports that would be helpful for program management. For the longer term, the working group

should additionally consider developing a system to allow utilities to perform on-line queries or to download the data so that they could create customized reports that best meet their needs. However, one challenge is that because the data are usually for more than one utility, the utilities must agree to make those data available to both utilities involved in a job.

2. Data Quality – The type and amount of quality control conducted on data entered into the system varied by contractor. While two contractors had formal data validation checks and balances, the three other contractors did not. In our use of the data, we found inaccuracies in the account numbers. We recommend that the utility managers require that contractors develop and submit a data quality control plan and that the tracking system include, as planned, additional data quality checks.
3. Evaluation Data – Previous research has documented the potential and actual health and safety benefits that result from energy efficiency services. Some of these impacts can be best documented using data that are collected on the audit paperwork, but that are not currently included in the tracking system data fields. Adding a few fields to the database would allow for analysis of the prevalence of these types of issues and how frequently they are resolved by the program. Comfort Partners could then document the health and safety impacts of the program.

We recommend that the following additional fields are added to the tracking system.

- Ambient CO pre and post
- Flue CO pre and post
- Gas Leak detected

Additional data items that would be useful in the evaluation are described below.

- Inspection Type – The database allows for assessment of the percent of inspections that were done and the pass rate and problems found. However, the system does not indicate the type of inspection that was done. It would be useful for the evaluation to have a better understanding of the comprehensiveness of inspections that were undertaken. This is a planned enhancement to the system.
- Measure Coding – It would be useful to have the system code measures as to whether or not they are included in the seasonal spending allowance. This would allow for a clean comparison of the amount spent on seasonal measures and the seasonal allowance that was calculated.

This New Jersey Comfort Partners Program is well ahead of many other utility efficiency programs, as it has provided detailed procedures and specifications for their contractors to implement. This includes procedures that have been updated as the results of findings from the previous comprehensive program evaluation. Many other utility efficiency programs rely on their implementers to follow procedures that are provided through WAP or other standards, rather than providing their own program guidelines.

This procedures review included recommendations for improving the organization of the manual, and improving and clarifying some of the technical information, procedures, and materials described. However, a full set of prioritized recommendations cannot be furnished until after the impact evaluation is completed. The impact evaluation will provide up-to-date

findings on the energy-saving impacts of the measure installation procedures contained in the manual, and may result in some specific recommendations for revising installation guidelines where measures are or are not found to be cost-effective.

The New Jersey Comfort Partners program follows a continual improvement process with frequent updates to the program procedures and the manual. The process has the benefit of providing state of the art techniques and implementing important findings from the field. However, it has also resulted in a manual that is patched together in places, and some confusion for contractors. Managers should consider a regular process for updates and adoption of those updates, so that implementers can have a better understanding of program expectations.

Eligible and Served Customers

This Needs Assessment provides a profile of New Jersey's low-income households using data from the 2009-2011 American Community Survey (ACS). These data provide information on the demographic characteristics, energy assistance needs, and efficiency service needs of low-income households throughout the state and by county. We focused on households with income at or below 225 percent of the poverty level, the income-eligibility standard for the program. The data represent the state in 2011.

Several key facts about this population are important for analyzing program need and eligibility for Comfort Partners services, and how this varies throughout the diverse state.

- 26 percent of households in New Jersey had income at or below 225 percent of the poverty level.
- About 62 percent of the low-income households had housing and energy bill characteristics that made them eligible for NJ Comfort Partners.
 - 85 percent of these households heated with natural gas or electricity.
 - About 78 percent lived in a housing type that is eligible (single family or multi-family buildings with no more than 14 units).
 - 90 percent paid directly for gas or electric.
- Some demographic characteristics can make it more difficult to serve segments of the population.
 - Only 39 percent owned their homes, and renters can be more difficult to serve, as landlord permission must be obtained.
 - 39 percent did not speak English in the home and may have the need for service provided in another language if a family or friend interpreter is not available.
- Many of these households had usage at a level that indicates a need for energy efficiency services.
 - 50 percent of those who did not heat with electricity were estimated to have annual electric usage over 8,000 kWh.
 - 24 percent of those who heated with electricity were estimated to have annual electric usage over 16,000 kWh.
 - 55 percent of those with gas heat were estimated to have annual gas usage above 1,200 ccf.
- Another key finding from this analysis is the extent of diversity across the state.
 - *Poverty level:* While 26 percent of households were income-eligible for NJ CP in the state as a whole, the percent eligible varied from 14 percent to 36 percent in various

- counties. Five counties had less than 20 percent income-eligible and five counties had 30 percent or more income-eligible for NJ CP.
- *Main Heating Source:* The majority of households in most counties used natural gas as the main heating fuel, but this was not the case in four counties.
 - *Home Type:* The majority of low-income households in 14 counties lived in single family homes, and the majority of low-income households in six counties lived in multi-family buildings.
 - *Language:* The percent of low-income households who spoke English at home ranged from 32 percent in one county to 87 percent in another. The percent of low-income households who spoke Spanish at home ranged from five to 52 percent.
 - *Eligibility for Comfort Partners:* We estimated that 62 percent of low-income households in New Jersey were eligible for Comfort Partners because they had gas or electric heat, paid their utility bill directly, and lived in an eligible housing type, but this percentage varied from 30 percent to 79 percent in various counties.

These factors should be reviewed when thinking about the challenges, possibilities, and strategies for the NJ Comfort Partners Program in different parts of the state.

The NJ Comfort Partners tracking database provides rich information to examine the population of households served by the program, their home and job characteristics, program spending and measures, and inspection results. These data add greatly to the understanding of who the program is able to serve and how these services are delivered.

- **Demographics:** Most of the households served by Comfort Partners, about 70 percent, had at least one vulnerable household member who was a child, elderly, or disabled.

The majority of households served had extremely low annual household income, of less than \$20,000. Only five percent had income of more than \$40,000. While about 35 percent had employment income, about 25 percent had retirement income, 13 percent received public assistance, 11 percent received disability, and seven percent received unemployment income.

While the Needs Assessment found that 59 percent of income-eligible households rented their homes, the tracking database analysis showed that only 30 percent of those served were renters. However, some low-income renters would not be eligible because they lived in buildings with over 14 units or did not pay directly for electricity or gas. EIC and Northeast Energy were more successful than the other contractors at serving renters.

- **Home Characteristics:** About 70 percent of the homes treated were single family and most of the rest were multi-family homes. Row homes were about ten percent of those served, and mobile homes were only about three percent.

About 90 percent of treated homes had natural gas heat and about ten percent had electric heat. Supplemental heating was used in a large percentage, 38 percent, of homes. Almost all of the supplemental heating was electric heating.

- **Pre-Treatment Usage:** Pre-treatment energy usage has been found to be highly related to the amount and percent of pre-treatment energy usage saved. The NJ Comfort Partners program benefits the efficiency of administration by providing joint delivery of electric and gas service, and also makes the program more convenient for customers. However, the linkage can limit the ability of an individual utility to serve only its highest usage

customers. This results from the fact that if the customer is targeted for service by the gas utility, the electric utility will serve the customer regardless of the usage level.

- A good benchmark for an effective gas program is to serve customers with usage of 1,200 ccf or higher annually. The analysis showed that mean pre-treatment usage for customers with gas heat and gas water heat was 1,030 ccf, but that 25 percent had usage of 1,200 or higher. This compared to 55 percent seen in the eligible population analysis.
- Electric baseload usage programs are often found to be effective when usage is 8,000 kwh or more annually. Customers with gas heat and hot water averaged 7,837 pre-treatment electric usage and the median was 7,200 kWh.
- Electric heating programs frequently define high use as 16,000 kWh or more annually. Homes with electric heat and hot water averaged 13,815 in pre-treatment use, and 25 percent had usage of more than 16,215. This compares well to the 24 percent found to have usage over 16,000 kWh in the eligibility analysis.
- **Testing Results:** One third of the jobs did not have a pre-treatment blower door test and 52 percent did not have a post-treatment blower door test. Contractors reported that they were not able to do blower door tests due to health and safety issues, such as mold, asbestos, vermiculite insulation, use of breathing apparatuses or other medical equipment, and customer refusals. The percentage missing either a pre- or post-treatment blower door test varied widely by contractor.

When examining the half of the homes that had pre- and post-treatment blower door test results, the analysis shows that 19 percent had a reduction of 1,000 CFM50 or more, and eight percent had a reduction of 1,500 CFM50 or more. The mean reduction was about 600 CFM50.

Refrigerators were monitored in about 80 percent of the treated homes. This also varied greatly by contractor, from 56 to 90 percent of the homes treated. The metering results showed that about 56 percent of the metered refrigerators had usage over 1,000 kWh, most of which would be eligible for replacement under the program.

- **Measures:** Measure installation was examined both by protocol savings category and by detailed measure group. The protocol savings category analysis showed that 79 percent had CFL's installed, 65 percent had air sealing, and 61 percent had hot water measures. Other categories where about one third or more of the jobs had measures were HVAC, refrigerators, thermostats, duct sealing, and insulation. The percentages varied widely by contractor.

The program database provided a detailed list of 406 different measures. We combined these into measure categories for the purposes of analysis. The most common measures, with penetration of over 85 percent, were the audit, energy education, and combustion testing. Health and safety measures were provided in 78 percent of homes, air sealing was done in 60 percent, and attic insulation in 27 percent.

While 98 percent of jobs with gas heat and gas water heat had a health and safety measure, 61 percent of those with electric heat and electric hot water had a health and safety measure.

The information will be incorporated into the usage impact analysis to assess measure-level impacts and program targeting, and to make recommendations for refining the program procedures.

We conducted 977 telephone interviews with customers who participated in Comfort Partners and had their installations completed approximately one year prior to the survey. Key findings are summarized below.

- Respondent Characteristics – The customer survey collected information not available in the program tracking database. This information demonstrates that the program is serving a group of customers who have need for assistance.
 - 15 percent of customers served by Comfort Partners had one or more veterans in the household.
 - 47 percent reported that they received retirement income in the past year, 27 percent received cash assistance, and 22 percent received employment income. In addition, 40 percent received non-cash assistance.
 - 37 percent reported that someone in the household had been unemployed and looking for work in the past year.
- Reasons for Participation
 - The most common source of information (27 percent) for the program was a friend or relative.
 - 61 percent reported that the main reason they wanted to participate in Comfort Partners was to reduce their energy bills.
- Understanding of Energy Bill
 - While 43 percent of one contractor's customers reported that the provider reviewed the energy bills, 24 to 35 percent of the other contractors' customers reported this.
 - 48 percent reported that the provider explained how energy use is measured. One contractor's customers were less likely to report that they received this information.
 - 78 percent reported that they felt they had a good understanding of how to review their energy bill.
- Action Plan and Actions Taken
 - 54 percent reported that the service provider furnished a written plan of actions to save energy. This ranged from 44 percent for one contractor to 58 percent.
 - 27 percent reported that the service provider told them how much money they could expect to save by taking the actions on their plan.
 - 60 reported that they had taken energy-saving actions, and when asked what they did, 48 percent reported at least one action.
 - Customers of two contractors were more likely to report that they reduced their heating, hot water, and air conditioning usage than the others.
- Program Measures
 - Most customers, 92 to 95 percent, reported that they were very or somewhat satisfied when asked specifically about insulation, air sealing, and heating system work.
- Home Comfort
 - 50 percent said that the winter temperature in their home improved and 39 percent said that their summer temperature had improved.
- Satisfaction
 - Most customers provided high ratings for all aspects of the program.
 - 84 percent stated that the program was very or somewhat important in helping the customer to meet his or her needs.
- Recommendations

- Customer need
 - The survey found customers were likely to be veterans, receive cash and non-cash assistance, or to have been unemployed in the past year.
 - *Recommendation – The Comfort Partners Program should assert that one important program benefit is that they are helping customers in the state who are very much in need of assistance.*
- Program information source
 - Friends and relatives – The most common source of information for the program was a friend or relative.
 - *Recommendation – The prevalence of “word of mouth” marketing is an important reason to ensure that participants understand the program purpose, benefits, and customer role.*
- Energy education
 - Education provided – The survey found that two contractors were more effective in providing energy education and their customers were more likely to report that they took energy-saving actions.
 - *Recommendation – The utilities should provide additional guidance to the other contractors on providing energy education to customers.*
- Customer actions
 - Motivation for participation – The majority of customers, 61 percent, reported that the main reason they wanted to participate in Comfort Partners was to reduce their energy bills.
 - Monetary savings from energy usage behavior change – Twenty-seven percent reported that the service provider told them how much money they could expect to save by taking the actions on their plan.
 - *Recommendation – Providers should be trained to furnish education on potential dollar savings from energy actions, as customers are most interested in reducing their energy bills.*
- Program Satisfaction
 - Most rated highly – Most customers said they were very or somewhat satisfied with key aspects of the program and the providers.
 - *Recommendation – There is room for improvement in the percent of customers who say they are very or somewhat satisfied with the program and providers should work on improved customer communication.*

Quality of Service Delivery

We conducted 18 weeks of on-site observation of service delivery and observed 81 audits, 36 days of measure installation, and 12 final inspections. Observations were stratified by gas utility, electric utility and contractor.

A detailed data collection system was developed to assess whether key steps were completed and tests were conducted. The quality and comprehensiveness of services was also assessed. The information was collected by providing observers with forms and a database in which to record the information. The forms listed the expected steps for each stage of the process – the audit, the measure installation, and the final inspection. Rating scales will tally the number and percent of steps completed correctly.

The observations will quantitatively assess the quality of work done and will provide detailed data on where the program is succeeding, where procedures could be refined, and where additional training is needed.

We conducted 288 inspections of completed jobs. The inspections provide a statistically reliable analysis of the quality and comprehensiveness of Comfort Partners jobs. The approach is described below.

1. Sample – We recruited customers from a sample customers who completed the telephone survey and expressed willingness for an inspection. The survey sample was selected to be representative of the Comfort Partners population. Through the inspection period, we reviewed inspection completion statistics by electric utility, gas utility, contractor, and county to ensure that the inspections were representative of the program’s customers.

This approach had the following advantages.

- At the end of the survey, we informed customers about the inspection, the \$50 incentive that is offered to inspection participants, and assessed interest in participation in the inspection.
 - The survey confirmed that the customers are in the same home where services were delivered.
 - Customers who were not willing to participate in the survey were unlikely to agree to an inspection, so the survey provided an initial screening for willingness to participate.
 - The survey included customers who had Comfort Partners service delivery completed approximately one year ago. By inspecting these homes, we were able to determine if the measures held up for a year after service delivery.
 - We can link the results from the survey and the inspections together to provide increased information from the study.
2. Recruitment – We contacted, screened, and recruited a sample of households for a 3 to 4 hour on-site inspection. We paid clients a \$50 incentive in recognition of the time and effort required to keep the inspection appointment.
 3. Visit Protocol – Our inspection protocol had the following elements.
 - Data Retrieval – We extracted all relevant service delivery data for each sampled home, including pre and post diagnostics, installed measures, and costs.
 - On-Site Inspection – We sent a senior technician and a technician assistant (all with BPI certification) to conduct the inspection that included the following.
 - Diagnostic testing
 - Inspection of all installed measures for final quality and completeness
 - Identification of any missed opportunities
 - Discussion with the customer of health, comfort, and safety issues, as well as any client-related factors that may have led to exclusion of certain measures.
 - Post-Inspection Analysis – The data for each home will be analyzed in terms of measure selection, installation quality, and health and safety issues.

- Reporting – We will conduct an “investment” weighted analysis of the quality and completeness of the work done in the program. The report will furnish information on the effectiveness of the program in addressing the needs of each system in the home and an overall assessment of installed measures. Key indicators in terms of Measures will include the following.
 - Percent of Spending Appropriate (i.e., consistent with program guidelines) and Good Quality
 - Percent of Spending Appropriate but Poor Quality
 - Percent of Spending Inappropriate
 - Cost of Measures Appropriate but not Installed

This research will furnish a comprehensive understanding of what is done in the field, and why savings goals are or are not achieved. Moreover, this information will help program managers to refine program protocols in ways that increase the installation levels for appropriate measures, reduce installation of suboptimal measures, and focus attention on the key areas for improving installation quality.

Program Impacts

We obtained energy usage data from the six utilities and conducted weather normalized, comparison group adjusted analysis of the energy impacts of the program on natural gas and electricity consumption. The comparison group was comprised of later program participants.

Billing data analysis methods can be broadly grouped into two categories – house-by-house savings analysis and pooled analysis.

- House-by-house analysis: PRISM is an example of the house-by-house analysis, where energy usage for each home is analyzed for periods before and after treatment. Gross savings is calculated for each home as the difference between pre and post treatment weather-adjusted usage. Net savings is calculated by adjusting gross savings by the average change in weather-adjusted usage for comparison homes. In addition to PRISM, we utilized a degree day analysis that allows for a greater percentage of cases to be included.
- Pooled analysis is conducted using a regression model, where savings are not estimated for each home, but instead the model directly estimates the program savings as a parameter of the regression model.

For the target analysis period, because of the unusual weather patterns, it was particularly important to have more than one analytic technique. During the winter of 2011-2012, New Jersey experienced approximately 20 percent fewer heating degree days than the normal, and than the prior winter of 2010-2011. Moreover, the distribution of degree days by month was unusual and is likely to have resulted in idiosyncratic usage that can have an impact on the precision of gross and net energy savings models.

Findings from the usage impact analysis will be important in making recommendations for program treatments. The recommendations will address the following.

- Allowable measures
- Appliance replacement criteria

- Spending levels

We will also compare these findings to savings from other low-income energy efficiency programs around the country, and compare health and safety spending to programs around the country. We will compare predicted to actual savings and compute the savings realization rates.

We analyzed customer billing and payment data to estimate the program's impact on energy bills, energy burden, and energy bill payment. The following areas were addressed in this analysis.

- Energy bills: We compared pre and post-treatment bills for program participants. We disaggregated the reduction in bills into the segment that is a reduced customer payment and the segment that is a reduced USF subsidy.
- Energy burden: We calculated energy burden and compared post-program energy burden to pre-program energy burden.
- USF subsidy: The NJ USF program provides monthly credits to electric and gas customers to reduce their electric and gas energy burdens to six percent of household income. We compared pre and post-treatment USF credits for program participants. We estimated the amount by which the program reduced the ratepayer burden by reducing participants' usage and bills. We compared the percent of customers who reach the maximum USF subsidy in the pre and post treatment periods.
- Payments: We analyzed the number and amount of cash and LIHEAP payments made by participants in the year prior to service delivery and compared these payments to payments made in the year following service delivery.
- Coverage rates: We analyzed the bill coverage rate of these payments.
- Arrears: We analyzed the mean level of arrears and distribution of arrears for program participants one year after service delivery. We compared these arrearages to preprogram levels.

Findings and Recommendations

The NJ Comfort Partners Program is undergoing a comprehensive evaluation. The research tasks are complimentary and together will inform a prioritized list of recommendations to help the program meet its goals in the most effective manner. Initial research has provided some preliminary recommendations, but the forthcoming findings from on-site work and impact analysis will be critical in understanding whether and how program investments can be more effective.

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