PUBLIC IMPACTS OF FLORIDA'S PROPERTY ASSESSED CLEAN ENERGY (PACE) PROGRAM

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FOREWORD

The Patel College of Global Sustainability at the University of South Florida is pleased to present this report, "Public Impacts of Florida's Property Assessed Clean Energy (PACE) Program." This report received financial support from Ygrene Energy Fund, Inc.

The report is designed to build upon previous research and to explore the impact of PACE investment flowing into Florida since the conclusion of that research in July 2018 through November 2019. The research in this report highlights significant environmental and economic benefits achieved in a relatively short time-period that should be grasped by key stakeholders, the general public, decision makers, and people working in the clean energy services field. Understanding these benefits will assist in developing strategies to improve access to these services, both from the perspective of service providers, policy makers, and end-users. Key insights from this research can inform relevant government agencies and private entities to better understand and develop stronger approaches to build support for implementing public policies such as PACE across Florida.

I would like to acknowledge the hard work of the team members from the Patel College of Global Sustainability who managed to complete this important research project in a timely manner. I would also like to thank the team at Ygrene Energy Fund for providing resources to make this report possible.

I have little doubt that the findings of the study will make a valuable contribution toward guiding policy and strategic dialogues in Florida. The Patel College continues to be fully committed to working with all partners in support of reaching state-wide sustainability and resiliency goals to protect against hurricane damage, adopt clean energy, and invest in energy efficiency.

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PUBLIC IMPACTS OF FLORIDA'S PROPERTY ASSESSED CLEAN ENERGY (PACE) PROGRAM

EXECUTIVE SUMMARY

Property Assessed Clean Energy (PACE) is a tool for financing a wide range of energy, water efficiency, renewable energy, and hazard mitigation improvements that are permanently installed onto residential and commercial properties. This public-private partnership is established by state statute and enabled by local governments. Florida is one of several states (California, Ohio and Missouri are examples of others) that allows its residents and business owners to utilize the PACE policy for both commercial and residential properties. The current research team, from the University of South Florida (USF), sought to assess PACE and its impacts on the state of Florida. This research will take place in phases, but this work aims to extend prior research by Rose & Wei in 2019 (Ref. 1).

This white paper scaled the prior research to examine the substantial increase in investment in Florida by a leading PACE administrator, Ygrene Energy Fund, Inc. ("Ygrene"). This research sought to determine the added impact after the previous research and from inception. The investment of $393 million from August 2018 to November 30, 2019, with a total investment of $848 million since inception, yielded many direct benefits including reductions in energy use and greenhouse gas emissions and reduced hazard vulnerability to the state. These benefits also include economic benefits like job creation and state economic growth. The USF team analyzed these and other benefits in detail. Moreover, impacts of investments were evaluated for three separate regions of Florida: North, Central, and South. A large portion of the impacts were found in southern counties where Broward, Miami-Dade, and Palm Beach lead the way. The results for PACE in Florida indicate that during the most recent 16-month investment period by Ygrene, where data was available, PACE investment produced significant impacts. In summary, since the inception of the PACE program in Florida, the following overall benefits were estimated inception-to-date (through November 2019):

Electricity consumption reduction:	960 million kWh
Natural gas consumption reduction:	480 Mcf
Greenhouse gas emission reduction:	0.54 million metric tCO2e
Property damage from hurricanes avoided:	$970 million
Total person-year jobs created:	21,820
Gross State Product growth (GSP):	$1,140 million
Gross Economic Output growth:	$2,110 million

This white paper and scaling methodology are aimed to serve as a blueprint for others to follow when examining the performance of PACE in Florida and other states with similar PACE investment. This research also adds to the discussion of PACE being implemented in other states and the impacts that can be achieved when capital is invested in renewable energy, energy efficiency, and natural disaster resiliency.

BACKGROUND

Property Assessed Clean Energy (PACE) is a public policy tool for financing a wide range of energy and water efficiency, renewable energy, and natural disaster protection improvements such as hurricane resistant windows and doors that are permanently installed on residential, commercial, and industrial properties.

PACE is a public-private partnership established by state statute and enabled by local governments to increase local investment in sustainability and resiliency improvements to the built environment. PACE finances one hundred percent (100%) of the cost of qualified sustainability and resiliency improvements and removes the up-front cost barrier that property owners often face when contemplating clean energy or hurricane protection improvements. The property owner repays the financing annually or semi-annually through a special assessment that is added to the property owner's property tax bill. By structuring the financing as a special tax assessment placed on the property, PACE can increase access to affordable financing as compared to traditional credit-based financing options. According to the U.S. Department of Energy (Ref. 2) as of 2019, over 200,000 homeowners have made $5 billion in energy efficiency, renewable energy, and other improvements to their homes using PACE financing to install heating ventilation, and air conditioning systems (HVAC), hot water heaters, air sealing and insulation, energy efficient doors and windows, roofing, solar photovoltaic systems, water conservation, and resiliency measures such as wind hazard protection.

The improvements PACE programs finance are required by state statute to provide public benefits to the host state, of which there are direct benefits and indirect co-benefits. Direct benefits include reductions in energy use, water use, pollutants, and vulnerability to natural disasters like hurricanes. The investment that PACE mobilizes for sustainability and resiliency, utility bill savings, and insurance premium savings also generates economic co-benefits that include increases in local job growth, economic growth, and tax revenue among others. The Schwarzenegger Institute and the Sol Price School of Public Policy out of the University of Southern California recently performed this analysis, the most comprehensive analysis of the impacts of PACE to date (Rose & Wei, 2019: Ref. 1), utilizing data from a leading PACE administrator, Ygrene Energy Fund, Inc. This study examined the emergence and progress of PACE investment by Ygrene Energy Fund between 2013 and July 2018 in California and Florida, analyzing over 54,000 PACE improvement projects representing over $1 billion of sustainability and resiliency investment, including $455 million in Florida. This research will focus solely on Florida and examine what has occurred since July 2018 and its impact since inception.

Ygrene PACE financing in Florida has risen from $455 million over the course of five years, as detailed in the previous study (Ref. 1), to **$848 million adding $393 million of PACE investment from August 2018 to November 30, 2019.**

The significant growth in PACE investment in such a short time is worthy of examination to better understand the additional environmental, resiliency, and economic impacts of PACE in Florida. This research is timely, given Florida's geographical vulnerability to climate exacerbated disasters, such as more intense weather events as detailed in the Intergovernmental Panel on Climate Change Special Report (2018, Ref. 3), and the intensifying focus on the environment and sustainability in the state.

THE PACE PROGRAM **IN FLORIDA**

In the State of Florida, PACE programs operate through Special Districts, Interlocal Districts, or municipal districts, which are units of local government that partner with private PACE Administrators through a public-private partnership. Cities and counties that wish to offer PACE to their constituents can join these special districts through passage of a local city or county resolution opting into the district. These districts sell government bonds to private investors in order to raise the capital to finance PACE public benefit measures and are repaid through voluntary property tax assessments.

There are a variety of PACE districts in Florida, including:

the Green Corridor (the largest special PACE district),
the Florida Resiliency and Energy District,
the Florida Green Finance Authority,
and the Florida PACE Funding Agency.

PACE districts, and in some cases the cities and counties that join each PACE district, establish PACE program regulations and guidelines and oversee the PACE program and the private administrators that offer PACE financing on behalf of the PACE districts. All private administrators must partner with a PACE district to offer PACE financing as the authority to levy a PACE property tax assessment resides only with local governments and not with private financing companies.

INITIAL PACE INVESTMENT DATA

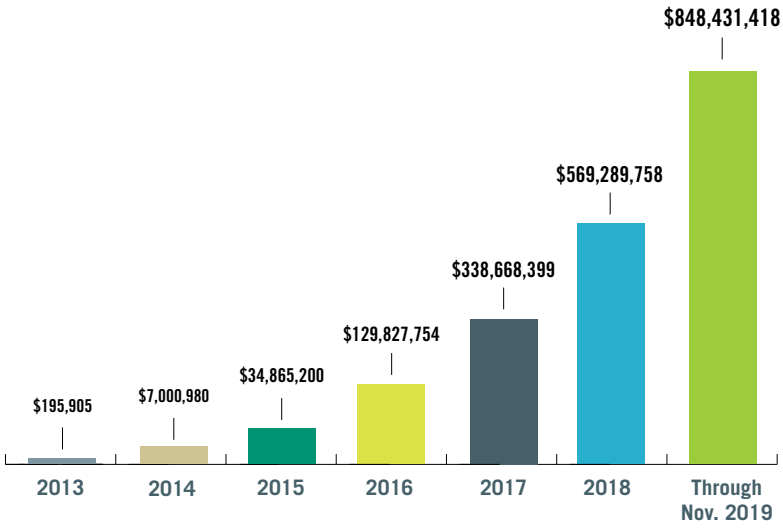
The data for this research was provided by Ygrene Energy Fund, Inc. to the research team in full in order to properly scale the direct and indirect impacts of the PACE investment that has occurred since the completion of Rose and Wei's (Ref. 1) research. The previous study examined the investment of Ygrene in Florida over the course of five years to a total improvement level investment of over $400 million ($455 million in total financed amount[1]). Since then, Ygrene added another $342 million ($393 million in total financed amount[1]) of PACE improvement level investment between August 2018 and November 30, 2019, in less than a year and a half. The substantial increase of 85% in funding over this period indicates a considerable interest in the outcomes of the program as funding has increased from an annual average of less than $100 million/year to over $250 million/year. This substantial increase in PACE investment in this short period of time, in addition to the resiliency, economics, and environmental impacts, is the focus of this research. Table 1 below shows the relative distribution of Ygrene PACE improvement types between 2013 and July 2018, August 2018 and November 2019, and the total combined (inception to November 2019). Cumulative investments increased from $129 million in 2016 to over $848 million by November of 2019 (Fig. 1), an increase of over 550% in less than three years.

***Table 1* – YGRENE FLORIDA IMPROVEMENT TYPE FUNDING DISTRIBUTION** (IN THOUSANDS OF DOLLARS)

Improvement Type	2013 - July 2018 (Ref. 1)	August 2018 - November 2019	Total Since Inception
Hurricane Protection	$275,786	$249,356	$525,142
Solar	$19,485	$29,136	$48,621
HVAC Efficiency	$34,676	$36,901	$71,577
Building Envelope Efficiency	$58,334	$15,453	$73,787
Energy Efficient Windows and Doors	$10,061	$7,432	$17,493
Lighting Efficiency	$1,760	$721	$2,481
High Efficiency Water Heating	$337	$562	$899
High Efficiency Pool Equipment	$268	$383	$651
Alternative Energy	$0	$1,593	$1,593
Other	$244	$0	$244
Total	**$400,951**	**$342,498**	**$743,449**

[1] Improvement level financed amount is equivalent to the raw cost of the improvements themselves. The total financed amount includes financing costs, program and government fees, and other costs not directly associated with the improvement cost itself. The improvement level financed amount contributes to energy, environmental, resiliency, and economic impacts, while the delta between the improvement level financed amount and the total financed amount only contributes to economic impacts.

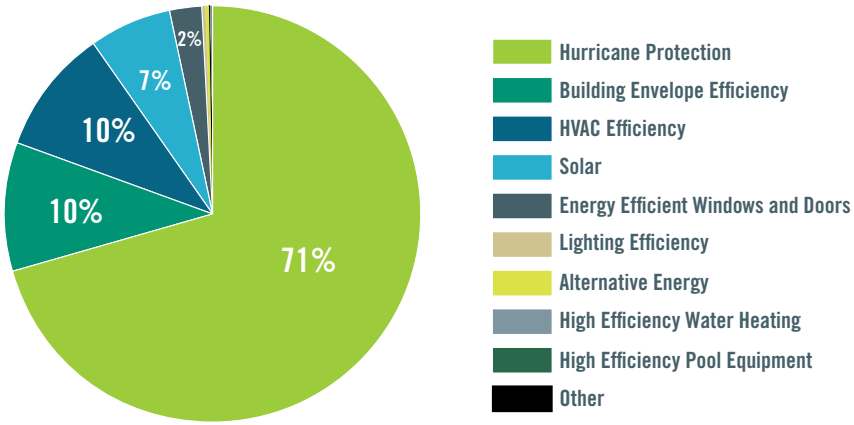
Fig. 1 – CUMULATIVE PACE INVESTMENT BY YGRENE IN FLORIDA



In comparing the investment distribution among the improvement categories since the conclusion of the previous research, we see a similar distribution in the types of improvements property owners have financed. The largest share of PACE investment in Florida continues to be Hurricane Protection improvements, representing 71%, (Fig. 2) which include high impact resistant windows and doors and roof reinforcement measures. Investment in building envelope efficiency, HVAC efficiency, solar energy, and window and door efficiency have remained among the top five improvement categories. Since the conclusion of the earlier study, it is important to note the change in investment in three major categories: solar, HVAC efficiency, and building envelope efficiency. During the 16-month period, since July 2018, PACE investment in solar has increased by almost 150%, while investment in HVAC and building envelope efficiency increased by over 106% and 26% respectively. This is reflective of a recent 2019 Pew Research Center report (Ref. 4) that found homeowners in South Atlantic states like Florida are increasingly more likely to install solar panels and high efficiency HVAC systems. The percentage of homeowners seriously considering installing solar panels has risen from 31% in 2016 to 51% in 2019. This trend could partly be driven by the availability of PACE as research out of the Lawrence Berkeley National Lab has shown that cities in California where PACE is available had higher levels of solar deployment than those without PACE (Ref. 5).

The data provided by Ygrene was used to scale the relevant environmental, resiliency, and economic impacts of PACE during the 16-month period. Additional information was obtained from Ygrene utilizing their "Ygrene Proprietary Impact Metrics Model," which is detailed in Rose and Wei's research (Ref.1). Ygrene's impact model was further reviewed by the current research team, analyzed for accuracy, and further leveraged to scale the environmental and resiliency impacts.

Fig. 2 – YGRENE PACE INVESTMENT IN FLORIDA BY IMPROVEMENT TYPE



IMPACT SCALING METHODOLOGY

The Regional Economic Modeling Incorporated (REMI) Policy Insight Plus Model (Ref. 6) was used in the original research to measure economic impacts of the PACE program. The REMI PI+ model is one of the most widely used macroeconomic modeling platforms in the world. It is a sophisticated input-output model that incorporates econometric and geographical components that allow for analysis of public policies that have localized impacts like PACE programs. The USF research team considers this model to be superb for measuring the economic impacts of the PACE program and, given it is an input-output model, is well suited for a linear scaling methodology for evaluating the economic impacts of Florida's PACE program assuming that the inputs into the REMI PI+ model are substantively similar.

Therefore, the research team used a linear scaling methodology for all economic impacts based on total PACE investment by calculating the impact per dollar of PACE investment ratio for each economic impact output (job years added, gross economic output, gross state product, income, etc.). The main assumption the research team is making in utilizing this scaling methodology is as follows: if the inputs (PACE investment in the various improvement categories) since the conclusion of the previous research are reasonably close to the inputs used in that research itself, it would stand to reason that the REMI model outputs would not vary. Given the strong similarity in the distribution of PACE investment among the various improvement categories, it is reasonable to assume the impact outputs would also share a strong similarity, and thusly a linear scaling methodology is warranted.

In order to scale the resiliency impacts, the research team took a similar approach to the Hazard Benefit Cost Ratios (BCR). As detailed in the previous study, each hurricane resiliency improvement has a specific BCR. Those BCR's combine across the $275 million of Hurricane Protection improvement spending noted in Table 1 and result in the $508 million in avoided disaster loss and $134 million in avoided displacement costs in the event of a hurricane. The research team takes those absolute values and divides by the total PACE investment in Hurricane Protection, arriving at a PACE program BCR for both avoided disaster loss and avoided displacement costs of 1.84:1 and 0.49:1 respectively, for a total combined BCR of 2.33:1. Thus, every $1 of PACE investment in Hurricane Protection leads to $2.33 of avoided disaster loss and displacement costs in the event of a Hurricane. These BCR's are then applied to the PACE investment in Hurricane Protection that occurred since July 2018 to determine the additional avoided hazard loss impacts.

In calculating the insurance savings impacts, the research team utilized the same primary source utilized in the previous study, the Florida Office of Insurance Regulation's Choices Tool (Ref. 7), and applied the adjusted insurance savings per hurricane protection project by county as the savings vary by location. A back of the envelope linear scaling calculation was used as a check against the insurance savings shown in earlier report compared to the insurance savings the research team calculated here, which is within a reasonable bound.

The energy and environmental savings impacts were scaled utilizing Ygrene's proprietary impact model, which was provided in full to the research team by Ygrene and subsequently reviewed by the research team for accuracy. A full explanation of that impact model is described in the previous report's (Ref. 1) section "A. Basic Data."

However, the research team recognizes that when scaling any data, one must assume a level of data accuracy degradation. Thus, the research team assumes the estimated impacts presented below fall within a reasonable sensitivity bound of plus or minus 10% in each impact category.

RESULTS

SCALED ENERGY AND ENVIRONMENTAL IMPACTS IN FLORIDA

The scaling methodologies above were used to calculate the increased energy and environmental impacts in Florida since July 2018. Table 2 shows the energy and environmental impacts between 2013 and July 2018, August 2018 and November 2019, and the total from inception to November 2019. Consistent with the substantial increase in funding levels over the short time period, the energy and environmental impacts showed similar benefits and savings since inception of the program. These included:

Change in lifetime electricity saved:	over 1X
Change in natural gas saved:	over 0.75X
Change in lifetime greenhouse gas emissions reduced:	over 1X
Change in Solar PV installed:	over 1.5X

***Table 2* – SCALED ENERGY AND ENVIRONMENTAL IMPACT DATA – RESULTS**

Improvement Type	2013 - July 2018 (Ref. 1)	August 2018 - November 2019	Total Since Inception
Lifetime Electricity Saved (million kWh)*	460	500	**960**
Lifetime Natural Gas Saved (Mcf)**	280	200	**480**
Lifetime Greenhouse Gas Emissions Reduction (million metric tCO2e)***	0.26	0.28	**0.54**
Solar Capacity Installed (MW)	5.3	8.7	**14**

*Total Electricity Savings since inception is equivalent to powering over 78,000 homes for one year (US EPA, Ref. 8).
**1 Mcf (Thousand Cubic Feet) is equivalent to 1 MMBTU.
***Total Greenhouse Gas Emissions Reduction since inception is equivalent to removing over 114,000 passenger vehicles driven for one year (US EPA, Ref. 8).

SCALED HURRICANE RESILIENCY IMPACTS IN FLORIDA

The overall hurricane protection PACE BCRs were applied to the improvement level investment amount in the hurricane protection improvement category as well as the adjusted county level insurance savings factors by hurricane protection project. The results of that scaling are shown below in Table 3. Florida state statute mandates insurance companies to offer premium discounts to policy holders who implement home improvements that reduce disaster risk. Insurance premium savings are estimated to increase by 77% during the past 16 months and Disaster Loss Avoidance and Disaster Displacement Cost Avoidance of 90% and 91% respectively. This demonstrates how PACE financing can play a significant role in hurricane mitigation.

***Table 3* –SCALED INSURANCE AND HAZARD LOSS AVOIDANCE DATA – RESULTS** (IN MILLIONS OF DOLLARS ROUNDED)

Improvement Type	Scaling Factor per Dollar PACE Investment	2013 - July 2018 (Ref. 1)	August 2018 - November 2019	Total Since Inception
Lifetime Insurance Premium Savings	NA	$710	$550	**$1,260**
Disaster Loss Avoidance	1.84	$510	$460	**$970**
Disaster Displacement Cost Avoidance	0.49	$130	$120	**$250**

SCALED IN-DIRECT ECONOMIC AND TAX IMPACTS

Utilizing the linear scaling methodology, a direct scaling factor was calculated and then applied to the total PACE investment since July 2018. This scaling factor shows the different economic impacts per dollar of PACE investment based on the results from the REMI outputs during the previous research period. Both the result of the scaling of that data, as well as the individual scaling factors, are shown below in Tables 4 and 5.

***Table 4* –SCALED IN-DIRECT ECONOMIC IMPACT DATA** (IN MILLIONS OF DOLLARS ROUNDED)

Impact	Scaling Factor per Dollar PACE Investment	2013 - July 2018 (Ref. 1)	August 2018 - November 2019	Total Since Inception
Job Years Created	0.000026	11,720	10,100	**21,820**
Gross State Product	1.34	$610	$530	**$1,140**
Sales Revenue / Gross Economic Output	2.48	$1,130	$980	**$2,110**
Personal Income	1.13	$510	$440	**$950**

Table 5 – **SCALED FEDERAL AND STATE/LOCAL IN-DIRECT TAX IMPACT DATA** (IN MILLIONS OF DOLLARS ROUNDED)

Impact	Scaling Factor per Dollar PACE Investment	2013 - July 2018 (Ref. 1)	August 2018 - November 2019	Total Since Inception
Personal Income Tax	0.141	$60	$60	**$120**
Indirect Business Tax	0.084	$40	$30	**$70**
Corporate Income Tax	0.075	$30	$30	**$60**
Total	**0.299**	**$140**	**$120**	**$260**

The results in each impact category (environmental, resiliency, and economic) have either slightly less than doubled or doubled since July 2018 and have delivered impacts within 16 months similar to the impacts that had previously occurred over 5 years. This is expected given the PACE investment since July 2018 was slightly less than the investment prior to July 2018. We would expect similar results in the future if PACE investment maintains its current trajectory.

FLORIDA REGIONAL ANALYSIS

The same scaling methodologies used for calculating energy and environmental impacts across Florida were used to calculate the year-to-date benefits for each region in Florida divided roughly into North, Central, and South Florida. The active counties in the regions are indicated below.

North Florida:	Alachua, Clay, Escambia, Levy, Volusia
Central Florida:	Brevard, Charlotte, Citrus, Hernando, Hillsborough, Manatee, Marion, Martin, Nassau, Orange, Osceola, Pasco, Pinellas, Sarasota, Seminole
South Florida:	Broward, Collier, Lee, Miami–Dade, Monroe, Palm Beach

Table 6 shows the PACE investment distribution in total financed amount across the three regions. South Florida has the highest PACE investment amount followed by Central Florida and North Florida respectively.

***Table 6* – YEAR TO DATE TOTAL PACE INVESTMENT AMOUNT BY FLORIDA REGION**

Impact	YTD Total PACE Investment Amount ($ millions)
North Florida	$2
Central Florida	$81
South Florida	$765
Statewide Total	**$848**

Table 7 shows the energy and environmental impacts from inception of the program to November 2019. Again, consistent with the larger funding levels in the Southern Florida Region, we expect substantially larger lifetime electricity savings, total natural gas savings, and total carbon abatements over the life of the program.

***Table 7* – YEAR TO DATE SCALED ENERGY AND ENVIRONMENTAL IMPACT DATA FOR EACH FLORIDA REGION**

Region	Estimated Lifetime Total Electricity Saved (million kWh)	Estimated Lifetime Total Natural Gas Saved (Mcf)	Estimated Life-time Total Carbon Abated (millions metric tons)
North	7	4	0.004
Central	189	120	0.110
South	768	355	0.430

In regionalizing the insurance savings and hazard loss and displacement costs, the results of this for each of the three Florida regions (North, Central and South) were analyzed and presented in Tables 8 and 9 below.

***Table 8* – YEAR TO DATE SCALED INSURANCE AND HAZARD LOSS AVOIDANCE DATA FOR EACH FLORIDA REGION**

Region	Estimated Adjusted Lifetime Insurance Savings ($ millions)	Estimated Avoided Disaster Losses ($ millions)	Estimated Avoided Displacement Costs ($ millions)
North	0.3	$1.3	$0.3
Central	30	$60	$15
South	1,230	$910	$240

***Table 9* – YEAR TO DATE SCALED IN-DIRECT ECONOMIC IMPACT DATA FOR EACH FLORIDA REGION**

Region	Estimated Job Years Created	Estimated Gross Economic Output ($ millions)
North	60	$6
Central	2,080	$200
South	19,670	$1,900

The PACE investment amount and scaled impacts above, however, are only representative of one PACE program administrator, Ygrene. Ygrene is a leading PACE provider in Florida representing approximately 80% of the total PACE market in Florida. Thus, the total impacts of PACE statewide, incorporating all PACE program administrators, would be higher than what is shown here.

FUTURE IMPLICATIONS AND CONCLUSIONS

The results above show that PACE is successful in delivering environmental, resiliency, and economic public benefits at scale and will continue to do so if the PACE market maintains a growth trajectory. Thus, the USF research team will look to explore future implications of PACE investment including further researching existing regulations, policies, and goals in Florida to examine how PACE could further support those initiatives. Policies the research team will analyze with respect to PACE include Florida's issues surrounding red tide algae blooms, further hurricane resiliency and mitigation, renewable energy generation goals, and home improvement contractor performance and customer satisfaction.

Also, the research will explore how PACE impacts federal policies, dollars, and programs like the National Flood Insurance Program. The 2019 National Oceanic and Atmospheric Administration's (NOAA) Annual U.S. Climate Report reveals that the U.S. experienced more than two times the number of billion dollar disasters during the 2010s (119) compared to the 2000s (59) and over 1,500 reported tornadoes in 2019, which was a top-5 year for tornado activity (Ref. 9). These increases in disasters and extreme weather events lend themselves to the benefits of PACE such as increased mitigation and resiliency. As the need for investment in sustainability and resiliency in the built environment grows, so too will the need for innovative policies like PACE. How those policies perform is of the utmost importance to federal and state government officials, legislators, local policy makers, and stakeholders who develop and implement these policies. This research team will analyze the intersection of PACE as a public policy tool with the new goals and policies that Florida and its local cities and counties across the state have established to address one of the most challenging issues of the twenty-first century: climate change.

However, PACE has not come without some criticism. PACE as a tax assessment allows the property owner to transfer the repayment obligations to a new owner upon resale like any other tax obligation. The Federal Housing Finance Agency (FHFA) and Fannie Mae and Freddie Mac have objected to PACE because it is a senior lien and primes the mortgage in the event of property foreclosure (Ref.10). The FHFA, acting as conservator of Fannie Mae and Freddie Mac, prohibited both from purchasing a residential mortgage where the property is subject to a senior lien PACE assessment. This may result in homeowners having difficulty selling their home or refinancing their mortgage as some mortgage lenders may (1) refuse to refinance an existing mortgage, (2) refuse to finance the purchase of the property, or (3) refuse to purchase mortgages in the secondary market when there is a current PACE assessment. This potentially means that the homeowner may be required to prepay the PACE assessment before the homeowner can close one of the aforementioned transactions. This position by these entities may be acting as a deterrent in the PACE residential marketplace, both in Florida and in other states considering enabling residential PACE programs, reducing the potential impacts of PACE. PACE programs have, however, taken steps to address this through upfront transparency to ensure that owners are aware of any issues with resale in their region before making any decision.

In conclusion, as Florida continues to evolve and strives to become a more sustainable and resilient state, PACE is a significant asset in these efforts. Through reducing environmental and carbon footprints while also acting as an economic stimulus, PACE continues to be a remarkable benefit to Florida.

AUTHOR INFORMATION

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