Memorandum

MIAMI-DADE COUNTY

Date:	May 4, 2022
To:	Honorable Chairman Jose "Pepe" Diaz and Members, Board of County Commissioners
From:	Daniella Levine Cava Mayor
Subject:	Report on Feasibility of Floating Solar Power Plants – Directive No. 191006

Agenda Item No. 2(B)(3)
July 7, 2022

As part of my operation to catch up on the backlog of items, we are bringing you reports that were pending from the previous administration.

The following report is pursuant to Resolution No. R-611-19, sponsored by me when I was Commissioner and adopted by the Board of County Commissioners (Board) on June 4, 2019, directing the County Mayor or designee to assess the feasibility of developing floating solar power plants on water bodies in Miami-Dade County, and to provide a report. The report addresses the potential for floating solar power plants to be placed on artificially created water bodies as well as explore opportunities to streamline regulatory reviews and to foster private sector competition to facilitate the deployment of floating solar power plants.

In accordance with Ordinance No. 14-65, this report will be placed on the next available Board meeting agenda. If you have any questions, please contact Lourdes M. Gomez, Director, Department of Regulatory and Economic Resources, at (305) 375-2886 or lourdes.gomez@miamidade.gov

Attachment

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Executive Summary

Floating solar power plants may be a viable power generation option for Miami-Dade County, provided further research and assessment. The novelty of the floating solar power plants and the variables of the water bodies in which they are deployed present a collective learning opportunity in how to treat them from a regulatory standpoint and what their ultimate benefits may be. This report attempts to capture the various methods for their application and provide recommendations but ultimately, each potential project can and should be evaluated for feasibility. As more floating solar power plants are deployed across the world, more observations and data will be made available for the County to make sound determinations on their use. As we learn more about how the floating solar power plants react in water bodies and our world continues its paradigm shift into fostering the creation of clean, renewable energy, the feasibility for their deployment will likely be expanded.

Background and Opportunities in Floating Solar Power Plants

On April 10, 2018, the Board of County Commissioners adopted Resolution No. R-292-18 pertaining to a Joint Participation Agreement (JPA) with Florida Power & Light (FPL) for the development of agreements for next generation energy projects including a "Floating Solar pilot program within the County to assess the viability and challenges of this novel approach." Subsequently, a license agreement between Miami-Dade County and FPL allowing for the installation of the first floating solar power plant was adopted via Resolution No. R-243-19 on March 5, 2019. The pilot project adopted in R-243-19 has begun demonstrating the feasibility in deploying floating solar power plants in water bodies throughout Miami-Dade County. However, feasibility of deployment to other water bodies will ultimately be predicated on factors including property ownership (lake/body of water), site-specific conditions (such as hydrogeology, salinity, environmental sensitivity), intended use, public access, and other regulatory variables. The extent of regulatory requirements also hinges on possible utility designations that entitle those entities to exemptions from the Florida Building Code, among others. It is important to note that the State of Florida regulates utilities through its Florida Public Service Commission (PSC) and specifies that only utilities can generate and sell electricity to end users. This principle contextualizes the variables at play for deployment of floating solar power plants and how the County would handle varying scenarios.

Solar energy can be generated by capturing sunlight through photovoltaic cells that are made primarily of silicon and convert the sunlight into electricity. Floating solar power plants, also known as floating photovoltaics (FPV), are an emerging but fast-growing technology. In 2017 globally installed capacity was only 198 megawatts (MW), which grew exponentially to 3.6 gigawatts (GW) in 2021, with some forecast predicting almost 10 GW to be deployed by 2025[1]. In 2021, China, India, and South Korea accounted for the largest floating solar projects, with

[1] Floating solar going global with 10GW more by 2025: Fitch | Recharge (rechargenews.com)

capacity of the largest site reaching 2.1GW.[2] The United States experienced a similar boom, from only seven systems in 2017, to over 20 systems in 2022 with an additional 12 projects in the pipeline. Nationally, total capacity currently installed is approximately 20 MW, with most projects located in Florida and California, and additional projects in Oregon and New Jersey. In Florida, the City of Orlando and Orange County have the most projects installed and several new FPV sites in the pipeline. The City of Orlando in partnership with the utility has installed 1.2 MW of floating solar across the metropolitan area. Currently, projects are only permitted on stormwater retention ponds with ongoing research to determine if there is leaching or other negative effects to the water quality or wildlife. Moreover, the floating solar arrays did not undergo any damage during Hurricanes Maria and Irma, two high-speed wind events in 2017.

Floating solar power plants demonstrate unique energy and non-energy co-benefits compared to land-based photovoltaic systems. Energy benefits include higher efficiency in energy production of 1.5-22 percent, while non-energy benefits refer to avoidance of land-energy conflicts (fuel vs food, land for conservation), water evaporation reduction, minimal impact on wildlife, and reduction of algae growth. Our state is ripe for floating solar power plants because of our high land values, high evaporation rates, power generation potential from sunshine, and abundance of water surface area from artificial water bodies, as noted in a 2019 study published in the Environmental Science & Technology journal.[3] Yet, because floating solar power plants are not yet wide-spread technology, the study information referenced above is derived from a small sample size. Moreover, there is a lack of empirical data documenting the long-term system performance, financial burdens and opportunities, operations and maintenance, material science, environmental and health impacts, as well as other key factors. Industry representatives have stated that the cost of floating solar power plants is similar to ground mounted solar systems (which is less expensive than roof-mounted solar systems). Finally, the high-level data used and analyzed lacks the level of resolution necessary for case-by-case feasibility and further analysis should be conducted as well as case studies on individual water bodies. Even so, Florida's sunshine is currently the most promising source of renewable energy. The abundance of sunshine in South Florida provides an opportunity to harness some of this solar power to meet the electrical energy demands of the population and offset utility peak energy demand.

Water Bodies in Miami-Dade County

[2] World's biggest floating solar farms: Top ten by capacity (power-technology.com)

[3] Floating Photovoltaic Systems: Assessing the Technical Potential of Photovoltaic Systems on Man-Made Water Bodies in the Continental United States

Robert S. Spencer, Jordan Macknick, Alexandra Aznar, Adam Warren, and Matthew O. Reese

Environmental Science & Technology **2019** *53* (3), 1680-1689

DOI: 10.1021/acs.est.8b04735

The state of Florida's current utility scheme restricts an entity such as the County, or a private entity, from generating and selling power to other entities (performing as a utility) as that activity is limited to only state-designated utilities. However, opportunities to deploy floating solar power plants exist for both private and public entities in Miami-Dade County.

Throughout Miami-Dade County, privately-owned water bodies and lakes exist for potential siting of floating solar power plants. It is especially feasible for a private entity such as a commercial business, office park, homeowner's association, a homeowner with a body of water on their property, etc. to deploy a floating solar power plant to support or offset their electrical/power requirements. Further, it is also feasible for a private owner to lease their body of water for possible deployment of a floating solar power plant, subject to prevailing regulations as noted below. Private entities interested in deploying the technology would be subject to different regulations than those affecting utilities and/or government entities.

Many of the larger water bodies in Miami-Dade County considered "lakes" are currently privately owned, used for rock mining, and/or located in the wellfield protection areas (WPA). The map attached to this report as Exhibit 1 provides an estimation of lake ownership and location. When some of the privately held lakes currently used for rock mining reach the end of their rock mining utility, some may become County property. The County may then consider them for floating solar power plants on a case-by-case basis. The private entities that currently own the lakes are free to and are encouraged to consider whether floating solar power plants are a feasible option for their power generation needs.

Given the data so far available, it is recommended that floating solar power plants should first be installed in water bodies outside of the WPA. Exhibit 1 also depicts which lakes are located within and outside of the WPA.

As further described below, private entities deploying floating solar power plants for their on-site uses would be required to obtain the proper building, environmental, and zoning permissions from relevant jurisdictions.

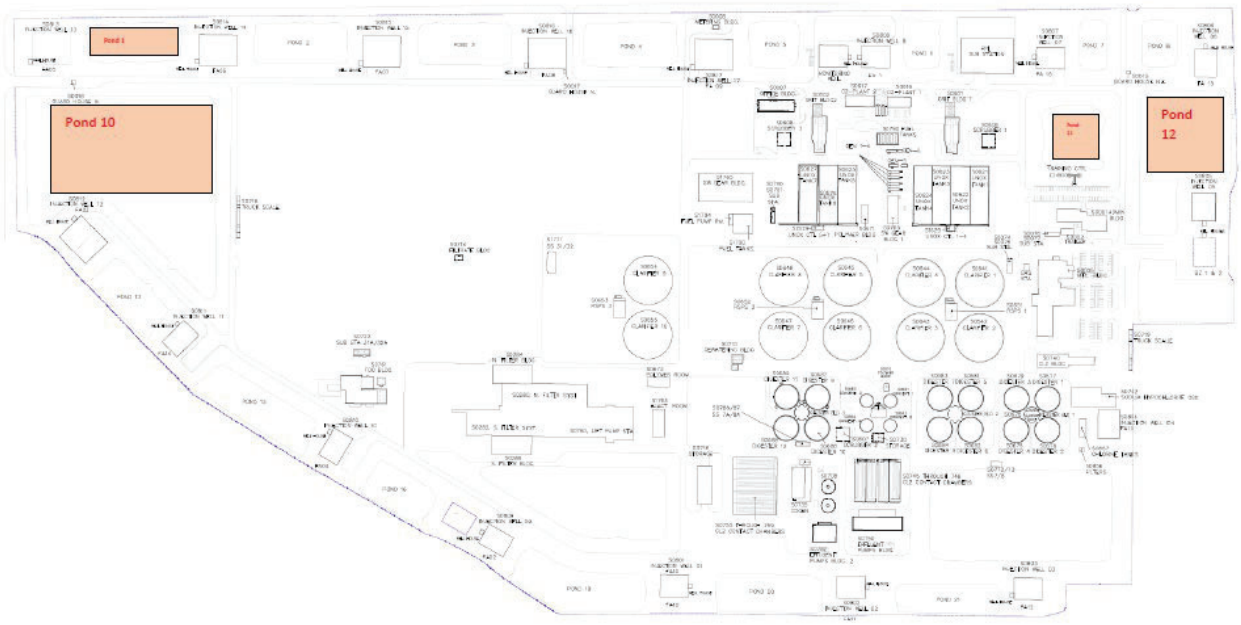
Water Bodies Owned by Miami-Dade County

Feasibility for generation of power for use on County facilities is dictated by the proximity of a facility to an adjacent and suitable water body. The County facility using the power would have to be in close enough proximity to physically connect to the floating solar power plant.

At the time of this writing, the County is reviewing some of its facilities with water bodies close enough to "tie-in" floating solar power plants to their on-site electricity system. Among those potential sites are a Community Action Human Services Department (CAHSD) facility and a Water and Sewer Department (WASD) facility which will be included in an upcoming solicitation to install on-site solar systems at several county facilities. WASD has studied the feasibility of installing a pilot floating solar power plants on an existing manmade retention pond at its South Dade Wastewater Treatment Plan (SDWWTP). Utilizing this existing surface area of the pond to install a floating solar power plant would enable WASD to reserve existing land for future

infrastructure expansion. The SDWWTP requires approximately 8-10 Megawatt hours (MWh) of electricity to process the approximately 100 million gallons of wastewater it receives each day from homes and businesses in the southern portion of the county. The site currently has the capacity to produce 3 MW of energy through the cogeneration of wastewater biogas, which represents more than $1,000,000 in electrical service. Expanding the use of renewable sources will result in further reduction of net energy costs and locking in an energy rate for the over 20 years of service of the renewable energy system. A pilot project would help to determine the performance of this technology and the energy production rates of panels on water, which may be higher due to the cooling effect of the surrounding water.

WASD has four lakes large enough to accommodate a floating solar power plant installation. The water surface area of these lakes totals approximately 477,000 square feet, the equivalent of 10.9 acres, and an energy generation capacity of 3.84 MW. “Pond 10” was identified as the ideal pilot location due to its size and proximity to on-site electrical distribution infrastructure such as power inverters and substations.



It may be feasible to license access and use to County-owned water bodies to a designated utility such as FPL or Homestead Public Services Energy (HPS Energy), an arrangement similar to Glide Angle Lake, the water body that houses FPL’s first floating solar power plant within Miami-Dade County (pictured below).

Regulatory Considerations

A variety of regulatory mechanisms may be applicable for the permitting and installation of floating solar power plants. The extent of regulation would depend on site-specific factors such as, but not limited to, intended use, the landowner or lessee, the installer, and the governing local jurisdiction (whether in a municipality). For example, entities classified as utilities such as FPL or HPS Energy are subject to some, but not all, regulations that apply to an entity not classified as a utility. Both non-utility entities and utilities are subject to Chapter 24 of the Code of Miami-Dade County and its applicable environmental reviews. In a scenario where the County leases its body of water to FPL or HPS Energy, the utility would be subject to some of the County's regulations while being exempt or subject to other county, state and/or federal regulations.

Regardless of the extent of regulation called for, we understand floating solar power plants to likely be a powerful tool for adopting alternative cleaner energy sources in Miami-Dade County. Should the floating solar power plants present unforeseen impacts or challenges, those negative impacts should be mitigated with equally innovative solutions. Additionally, the floating solar power plants allow for relatively easy deinstallation and removal, which speaks to their utility and flexibility. Regulating jurisdictions should consider this throughout permitting and monitoring.

Building Permit Considerations

An application by a non-utility for a floating solar power plant would require a building permit. The Construction, Permitting, and Building Code (CPBC) Division of the Department of Regulatory and Economic Resources (RER) regulates construction in the unincorporated areas of Miami-Dade County while municipal building departments have

jurisdiction in their respective municipalities. Facilities of electric utilities, as defined in Section 366.02, Florida Statutes, which are directly involved in the generation, transmission, or distribution of electricity, are exempt from the Florida Building Code (FBC). Section 102.2 of the FBC provides the exemption. However, private, or other floating photovoltaic structures and facilities are subject to the requirements of the FBC and must obtain a building permit for construction. The High Velocity Hurricane Zone (HVHZ) wind provisions and the National Electric Code referenced in the FBC would help to regulate the system's design. The FBC would dictate how a private floating solar power plant would be designed and ultimately approved but it should be noted that designs of these systems could be specific to the conditions of the body of water for which they are intended. Ultimately, the Building Official of each jurisdiction is authorized by the FBC to request special inspections, calculations, plans, etc. to ensure floating solar power systems are free from life safety issues. The inert nature of this technology and the various site conditions may require novel reviews and/or raise questions for which the FBC may not have a prescription, but that the Building Official(s) would certify for safety and compliance using additional methods of engineering.

The designs of floating solar power plants would have to ensure that the water is not being energized, the system is properly anchored, that the water body use (such as for recreational purposes) does not conflict with the floating solar power plant, the system meets HVHZ standards, among other requirements. Additionally, any plans must state whether the harnessed power will be stored in batteries, immediately consumed, or if any excess energy would be fed back into the power grid.

Environmental Considerations

Environmental considerations pertaining to deploying floating solar power plants in water bodies throughout Miami-Dade County should consider minimizing impacts to natural resources and protecting water quality. RER's Division of Environmental Resource Management's (DERM) regulatory authority as per Chapter 24 of the Code applies countywide. However, Chapter 24 does not regulate the products used in solar panels (regardless of whether those materials are indicated for use over land or water). As this is an opportunity for DERM to review and provide a recommendation on the use of floating solar panels, the below factors have risen as considerations. Solar panels are or have been installed across the country and the world, providing for incredible reductions in greenhouse gas emissions and a more sustainable energy source, but special attention should be paid prior to considering deploying floating solar power plants over sensitive areas, especially in the WPA. Deployment of floating solar power plants in water bodies within the WPA is not recommended until further studies become available on how the chemicals that comprise the photovoltaic cells may impact water quality. The absence of a soil buffer between the land surface and the aquifer may facilitate direct groundwater-surface water interactions and may provide a direct pathway for contaminant transport to groundwater. Additionally, the lakes, as open water bodies, provide for enhanced contaminant transport and increased contaminant transport velocity. As such, installations

over surface water bodies in proximity to potable water wells (i.e., WPA) represent a special potential hazard. The Wellfield Protection Ordinance and the hazardous materials prohibition are strictly enforced as the Code of Miami-Dade County includes restrictions and regulation of certain activities within WPA to protect our drinking water supply. With solar technology being relatively new, there is a dearth of data that can be relied on to give a feasibility recommendation for the WPA at this time. Therefore, use of water bodies in WPA should be avoided until further studies or additional data are available to address this concern. As the technology is tested and further data becomes available, the feasibility for floating solar in the WPA will be revealed and consideration could then be given to water bodies in the WPA. The various materials that comprise the floating solar power plants require further evaluation for their possible degradation in Miami-Dade's subtropical environment before contemplation of installation in WPA. National experts, such as the U.S. Department of Energy and its affiliated National Renewable Energy Laboratory, are conducting research on the long-term performance, and reliability of photovoltaics in an effort to quantify long-term degradation of the components.

However, there are fewer restrictions in other areas of the County that are outside of WPAs due to the greater physical distance or geographical separation from this activity and sensitive wellfield water supply wells. Therefore, water bodies that are located outside of WPA would be considered most feasible for deployment of floating solar power plants at this time. Deploying floating solar power plants in these areas could be considered for initial pilot projects and would provide an opportunity for testing this approach for use of this technology in our environmental setting.

Should an entity, whether the County, a private party, a utility, etc. plan to deploy a floating solar power plants in a body of water outside of the WPA, DERM would recommend baseline sampling (prior to installation) and subsequent routine sampling of the water body and sediments, to monitor for potential impacts on water quality. Understanding the data on how the floating solar power plants react outside of the WPA will provide critical information to guide decisions regarding deployments within the WPA. DERM is implementing a water quality monitoring program, at the Glide Angle Lake floating solar power plant, commencing in March 2022. This data will inform the understanding of water quality impacts, if any, resulting from these floating solar power plants. Depending on the location of the water body, further environmental permitting or other regulations may be required. For example, a Class III permit is a proprietary permit that would be required for work in non-tidal lakes, canals, rivers, and other water areas under direct control of Miami-Dade County. A Class IV permit would be required for work in freshwater wetlands anywhere in the county. Permits from the U.S. Army Corps of Engineers and/or State of Florida Department of Environmental Protection may also be required. For example, the floating solar power plant installed at Glide Angle Lake required a permit from the Florida Department of Environmental Protection prior to installation.

Further, artificial lakes in the Lake Belt Areas created through rock mining activities as well as development-based residential lakes, created to provide storm water retention during storm events, all feature a shore or a "littoral" shelf with ecological significance. The ecological function of these freshwater bodies is related to the presence of littoral zones

along the perimeter of the lake that can support submerged and emergent aquatic vegetation. Beyond the littoral zone, the deep-water areas of a lake are typically beyond the depth of effective light penetration and are too deep to support aquatic plant life. Aquatic plants play an important role in the ecology of a healthy lake. Therefore, floating solar power plants should avoid impacts to productive regions of the lake that support aquatic vegetation and would be best suited to the deep lake areas. To avoid adverse environmental impacts to flora and fauna that may be growing or utilizing freshwater lakes, it is recommended that only portions of lakes that are greater than 15 feet in depth be utilized for floating solar power plants. This is largely based on lake structure, including the depth at which light can penetrate the lake surface which allows for organisms to photosynthesize. Impacts relating to wading birds and other birds that utilize water for foraging, nesting or reproduction may be impacted by the physical space that is taken up by the floating solar power plant. In addition, there are limited studies out of California indicating that floating solar panels can sometimes mimic the surface of the water which can lead to collisions by waterfowl and birds of prey that result in serious injury or death to these birds. To offset this concern, the United States Fish and Wildlife Service has, in some circumstances, required that mitigation in the form of a similar habitat be created nearby. It is not yet clear how these studies and/or mitigation requirements from the most western part of the United States would translate into implementation and permitting scenarios for Miami-Dade County. Consideration should also be given to the type of anchoring systems and the location of anchoring systems to further minimize avoidable impacts to natural resources or wetlands habitat that may occur near the shoreline.

There may be benefits to the introduction of solar panels to freshwater lakes, particularly when temperatures are highest, and the sun is at its strongest. A floating solar power plant can shade the surface of the water making it less likely to be heated to temperatures that increase evaporative losses. Therefore, the solar panel coverage across waterbodies can result in less evaporation and increase the ability to store water within the lake system.

As more floating solar power plants are deployed, further studies and observations will likely bear more solid recommendations for environmental permitting. Further data that informs regulation will allow all the benefits of floating solar power plants to be reaped and offset any potential negative impacts.

Planning and Zoning Considerations

The Florida Legislature recently passed House Bill 1411 (HB 1411) which requires each local government to allow floating solar facilities as a permitted use under certain conditions and amend its land development regulations to promote the use of floating solar. The bill allows the county to adopt ordinances specifying buffer and landscaping requirements for floating solar facilities, however, such requirements may not exceed the requirements for similar uses involving the construction of other solar facilities that are permitted uses in agricultural land use categories and zoning districts. HB 1411 provides that a floating solar facility may not be constructed in an Everglades Agricultural Area

reservoir project if the local governments involved with the project determine that the facility will have a negative impact on that project.

Our current regulations would consider how the water body being considered for a floating solar power plant is zoned, and who installs the panels, in determining whether the floating solar power plant would be allowed by right, subject to a Zoning Improvement Permit (ZIP) or in need of a zoning hearing approval as an unusual use. In 2019, the Board adopted Ordinance No. 19-41, which defined a solar energy system and allowed it to be accessory to the main structures in residential areas and to be installed anywhere beyond the main building façade where other accessory structures are allowed. As applied to floating solar power plants, this ordinance allows for a homeowner to install solar energy systems in water bodies that they own and that are part of their contiguous property. Further, Florida Statute 163.04 prohibits certain local regulations of solar energy devices and is interpreted to allow for commercial and industrial zoned properties to install a floating solar system if the conditions of the statute are met. RER is developing an ordinance for the Board's consideration that formally complies with HB 1411 while adapting the allowed standards and parameters for the deployment of floating solar power plants in various land use categories. Among those considerations would be the impact of floating solar facilities on recreational activities, residential character, environmental implications and/or the ownership of the property and the ultimate use of the power.

Fostering Private Sector Competition

Utilities are exempt from competitive procurement processes under the Florida Statutes. This exemption allows the County to negotiate and enter into agreements with entities such as FPL or HPS Energy, as it did when crafting the license that allowed for the first floating solar power plant to be installed on County property on top of Glide Angle Lake. Resolution R-243-19 provided for a "non-exclusive license agreement between Miami-Dade County and Florida Power & Light (FPL) Company for the installation, operation and maintenance of solar electrical power equipment on Glide Angle Lake." R-243-19 provides a potential framework for future negotiations and/or licenses to allow for floating solar power plants to be installed in water bodies owned by Miami-Dade County. This license model could be replicated for future license agreements between FPL or HPS Energy and the County. If scaling this model, it should be noted that FPL, HPS Energy, or any other utility would remain exempt from competitive bidding and procurements.

Private sector competition could potentially be encouraged among non-utility exempt entities by issuing Request for Proposals (RFPs) and bidding opportunities such as Public-Private Partnerships (P3s) for licenses on the lakes that the County controls and where the County directly consumes the electricity. Pricing and demand are, of course, market driven. Any actions by the Board to stimulate the expansion of solar energy installations such as incentivizing floating solar power plants would be in support of prior Board actions and progress towards the adopted goal of achieving 30% of the County's energy from solar by 2030 and seeking to eliminate carbon emissions from energy used and produced in Miami-Dade County.

Owners of privately owned lakes may be more readily able to enter into lease agreements or arrangements with other entities to deploy floating solar systems subject to local, state, and federal regulations.