WORKING BETTER TOGETHER: Interagency Cooperation as the Key to Large-Scale Urban Water Reuse [1]

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KEYWORDS

interagency collaboration, recycled water, utility management, water management, water reuse

ABBREVIATIONS

USEPA	United States Environmental Protection Agency
WRAP	(National) Water Reuse Action Plan

ABSTRACT

The world's largest cities will need a range of alternative strategies if they are to supply their growing populations with water, now and in the future. In addition to continued conservation and efficiency efforts, the reuse of highly purified wastewater effluent (recycled water) is a key element in the portfolio of water supply solutions. In order to develop recycled water, the agencies that collect and treat wastewater and stormwater and those that supply water must all work closely together. In the United States, this type of cooperation is often inhibited by narrow political mandates and inflexible regulations, as well as the challenge of allocating responsibilities and costs among participating agencies. The USEPA's (February 2020) National Water Reuse Action Plan includes an initiative (Action Item 2.2.16) designed to "*support local and regional water reuse projects by identifying challenges, opportunities and models for interagency collaboration*." This paper discusses the authors' approach to investigating incentives and barriers to interagency partnerships, along with preliminary observations about strategies for building resilient, sustainable water supplies.

1. INTRODUCTION

Climate change and population growth increase the risk of water scarcity, especially in megacities in arid and semi-arid regions. As they struggle to avoid crises like Cape Town's "Day Zero," cities must find alternative water sources, including wastewater effluent suitably treated for potable and non-potable uses. (Edmond, 2019) As producers and distributers of recycled water, utilities must work together to share infrastructure, protect public health, educate customers, make necessary investments and collect adequate revenues, to make the most of increasingly limited water supplies.

The production and distribution of recycled water requires the collaboration of numerous public and private parties. By definition, water reuse brings together communities, wastewater agencies, municipal storm water programs, and drinking water agencies whose jurisdictions may extend over multiple regions and watersheds.

[1] ***NOTE***: *The views expressed in this article are the authors' and do not necessarily represent the views or policies of the USEPA*

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One of the most pernicious obstacles to developing sustainable water supplies is the inability of independent public agencies and private companies responsible for water management to work together effectively to solve complex water problems. To implement successful water reuse and stormwater capture projects, water agencies need to work across jurisdictional and program boundaries and share responsibility for designing, financing, building and operating recycled water systems. There are currently no legal templates, best practices, or other strategic resources available to facilitate this type of cross-program collaboration, in which agencies with separate mandates and management teams can work across their traditional boundaries. Providing such tools is critical to overcoming the barriers caused by fragmented water governance.

The USEPA Water Reuse Action Plan released in February, 2020 launched an action to investigate challenges and opportunities related to interagency collaboration as a key factor in the success of water recycling projects and resilience of urban water systems. This paper describes how the research team has framed issues, and how it intends to promote the interagency partnerships by developing tools to help utilities govern, finance, design, build, operate and manage water reuse projects.

2. APPROACH

As noted in the EPA National Water Reuse Action Plan Online Platform (https://www.epa.gov/waterreuse/national-water-reuse-action-plan-online-platform) the goal of this action item is to "*identify institutional challenges to water reuse, assess opportunities for interagency collaboration, and publicize agreements and other legal models that support implementation of water reuse and other integrated water management projects among "water cycle" utilities*." This effort is broken into the following steps:

- Identify the **motivations, opportunities, impediments, and tools** related to interagency collaboration for water reuse/capture.
- Investigate the **fragmentation of benefits and costs** accruing to the various water cycle stakeholders and assess its impact on project implementation.
- Examine how administration of water and wastewater **regulations** can affect interagency cooperation and suggest strategies to facilitate reuse.
- Explore the limits of **legislative mandates and incentives** for interagency cooperation in integrated water resource management, of which water reuse and stormwater capture are key components.
- Evaluate the ways that agreements can allow multiple agencies to work together as a **"virtual one water utility"** to plan, develop, implement, and operate recycled water projects.
- Demonstrate how utility managers and other stakeholders can resolve challenges and select **appropriate legal models** to lead successful interjurisdictional water reuse programs.

As of 2013, 36 of the 50 US states used recycled water. (Moulden, 2014) These uses include non-potable applications like agricultural and landscape irrigation, cooling and industrial processes, as well as potable use of municipal effluent. (National Research Council, 2012) From these hundreds of projects, the authors selected a small number to illustrate the mechanics of interagency collaboration, based on criteria including the number and variety of agencies involved; types of recycled water used; and geographic diversity to capture regional differences. They assessed each agency's perspective on a number of issues including its reasons for pursuing water reuse ("drivers"); allocation of costs through grants, loans, rates and fees; specific challenges to cooperation; and lessons learned. The authors hypothesized that agencies' ability to cooperate is directly impacted by 1) their legal structure; 2) the economic of reuse; 3) regulations on water use; and 4) technical issues related to the management and operation of recycled water systems. They also observed that interpersonal relationships and cultural differences among agencies can support or undermine cooperation, and that vision and leadership are often essential to maintaining effective partnerships. Examined within the context of US utilities, these lessons learned are relevant to the management of water and wastewater globally, in both developed and developing countries. (Bahri, A. et al. 2016)

2.1. Legal and Political Challenges

Many of the legal and political challenges that constrain public utilities from participating in reuse relate to the limited purpose for which these agencies were established, and the way in which their managers and directors interpret their purpose. Historically, water utilities in the United States were established to supply water to growing cities and provide water to irrigate farmland as the country expanded. These utilities were defined by jurisdictional boundaries, within which their goal was to offer ample water at low cost. As communities developed and reservoirs were incorporated into the water supply infrastructure, reduction of downstream flooding was sometimes added to the water agency's mission, or else a new agency was created to manage storm flows and control floods. Wastewater treatment developed much later, when pollution of area rivers and streams reached objectionable levels, often prompting formation of yet another utility. (National Research Council, 2012)

As illustrated in Figure 1 below, in large US cities today it is not uncommon to find different agencies responsible for each of these core urban requirements, further fragmented into wholesale and retail water utilities, sanitary districts responsible only for sewage collection, and discharge authorities whose sole task is to dispose of treated effluent. Each of these agencies may be run by a different manager and staff, and overseen by a separate board of directors.

Table 1. Sample roles and responsibilities of US water and wastewater agencies**.**

AGENCY OR AUTHORITY	ROLES AND RESPONSIBILITIES	PERMITS OR AGREEMENTS
State water agency	Allocate water rights and regulate quality	Legislative authority
Water wholesaler	Regional water supply	Water provider, federal and state health department certification
Water retailer or municipality	Local water supply	Water treatment and distribution
Sanitary district or municipality	Wastewater collection	State sewer operation permit or Sewer System Management Plan
Sanitation agency or municipality	Wastewater treatment	Federal and state pollution control permits
Wastewater discharge authority	Wastewater treatment and effluent disposal	National Pollution Discharge Elimination System permit or state land disposal permit
Flood control district or water conservation districts	Flood control; reservoir operation	Federal and state stormwater management and dam safety permits

Water recycling, in which wastewater is treated and reused as a water supply, inevitably requires these agencies to reevaluate their historic roles in order to work together effectively. This is no easy task, as each agency must comply with environmental and health regulations keyed to its mission. The agency's role may even be enforced by statute, in which case modifying its mission may necessitate amendment of the original enabling legislation. In the United States, most public utilities operate under the direction of governing bodies elected by the public or appointed by elected officials. Institutional issues take on a political dimension when these board members campaign on limiting the agency's mission to exclude reuse or reject investment in sustainable projects to keep water rates low. Insofar as all issues that influence the public may be considered political, successful collaboration requires each agency to be aware of the other's sensitivities. (Rosenblum & Anderson, 2005)

In summary, to fully appreciate how water recycling supports their agency's purpose those responsible must consider their responsibilities in the broadest context. For example, water utilities that value long-term reliability can justify investment in recycled water as a resilient, "drought-proof" local supply. Similarly, wastewater utilities concerned about future regulations on nutrients and organics can justify treating effluent to more rigorous recycled water standards in order to divert flow for irrigation. On the other hand, if agencies define their missions too narrowly, no partnership can occur. By broadening their perspective they can take advantage of the "economy of scope" that allows for more holistic solutions. (Wolff, 2004) Due to their long-standing organization as single-purpose agencies, many water agencies become highly "siloed" and develop distinct cultures that complicate interagency collaboration. (Tett, 2015) The urgency of the agency's need to reuse water or divert effluent flow may give those in charge the incentive to broaden their vision to sufficiently to encompass recycling.

2.2. Economic Challenges

Economic issues mirror legal issues, but they focus on the costs associated with utility operations that reflect the disconnected manner in which water is managed. Since many utilities were established when water supplies were abundant and receiving streams could readily assimilate discharges, their purpose may be to keep rates low. To the extent that agencies are only allowed to invest in projects that directly achieve their statutory goals, they may be prevented from working together to construct projects (like water reuse), even when all utilities collect from the same group of customers and the projects would result in the lowest total cost.

Defining carefully who benefits from water reuse can help agencies work through their institutional barriers by establishing a basis for project costs to be allocated. For example, if the key beneficiaries are potable water utility customers (because a needed supply enhancement is made available), a wastewater agency may struggle to justify adding a costly expense for enhancing its treatment processes to produce effluent suitable for another agency's use, even when the same community is served by both utilities. However, when the benefit to the wastewater agency is identified and monetized (e.g. as the value of reducing pollutant discharge through diversion) they may more easily justify placing the reuse expense on their ledger and passing the cost to their customers.

One solution to this economic challenge is for agencies to agree together on the monetary value of water reuse and simultaneously identify the beneficiaries. Where imported water supplies are limited due to drought or prior appropriation, the value of having a resilient water source like locally-produced recycled water can be compared to the cost of the reuse project. Incorporating collateral benefits like improved water quality or, in the case of stormwater capture, flood control benefits, can substantially improve project valuation. It is up to each agency, however, to identify and monetize the benefit of increased reliability into a proportional share of the project cost, and it must communicate the rationale for the increased cost both to the other agency partners and to its ratepayers.

2.3. Regulatory Challenges

As illustrated in Table 1, each agency involved in a reuse project must comply with a number of regulations. These regulations can incentivize reuse, for example when using recycled water can help agencies meet both water supply limits and wastewater discharge rules. On the other hand, rules governing recycled water use may be overly prescriptive and prevent its widespread application. Water rights laws may also inhibit recycling within certain boundaries or may prohibit withdrawing too much discharge from a waterbody when downstream users have come to rely on that discharge. These issues are not insurmountable, but add complexity to interagency relationships and may deter reuse.

Regulatory challenges also emerge when production and use of recycled water compromises the agency's ability to meet its existing regulatory limits. For example, when the concentration of pollutants from membrane treatment of recycled water jeopardizes a wastewater agencies ability to comply with discharge regulations it is unlikely to pursue reuse. Similarly, a water agency would not participate in a recycled water project unless it was assured that testing and operational protocols prevented it from introducing pathogens into its distribution system causing it to violate its water quality permit. In either case, the agency responsible for meeting regulatory standards will want to minimize its risk as a condition of its participation in a reuse project. For projects to succeed, all partners need to understand the needs, constraints, and regulatory or economic contexts in which the others operate.

2.4. Technical and Managerial Challenges

Just as utilities must ensure that water reuse does not interfere with compliance, they must also coordinate management of the recycled water system so that each agency can do its part without impairing its existing operations. Table 2 lists several responsibilities that must be described and assigned in interagency agreements that provide for water reuse, including system ownership, financing, and liability for regulatory compliance.

Table 2. Technical and managerial elements of water reuse agreements to coordinate system operation

Category	Purpose	Example Terms
Water quantity and quality	Define amount and quality of recycled water provided	Annual supply, maximum daily flow and peak hourly flow rate Maximum and minimum system pressure Treatment methods used Chemical and biological quality and constituents of concern
Operational responsibility	Delineate responsibility for all aspects of system operation and maintenance	Responsibility for leaks and breaks and restoration of service Notification of deviations in water quality or pressure Supply of alternative water source during system shutdown
System Infrastructure	Describe condition, location and ownership of system assets	Location of mains, laterals, turnouts Ownership of treatment, distribution facilities Distribution of grants, revenues (if jointly owned) Responsibility for asset management and capital replacement
Regulatory compliance and risk management	Assignment of responsibility for compliance with regulations and liability for future events	Permit authority under which recycled water is distributed Responsibility for monitoring and reporting water quality Responsibility for illegal discharges Permitting, inspection and monitoring of users and site supervisor training Mutual indemnification Limitations on liability (“Hold harmless”)
Financial terms	Compensation for water, payment of capital and operating expenses	Wholesale and retail water rates and escalators (e.g. CPI) Measurement and verification of water deliveries Other fees and charges (e.g. maintenance, training, billing Invoicing and payment terms (metered use, “take or pay”)
Public Communica-tions	Representation of reuse program issues and impacts to policy makers and public	Responsibility for communicating to the public during project development and implementation (too many voices inhibit effective communication and clear communication is essential to the success of a project in development and over time)

3. EXAMPLES OF STRATEGIES AND TOOLS THAT FAVOR SUCCESSFUL INTERAGENCY AGREEMENTS.

Along with successful reuse programs, as they illustrate challenges to interagency cooperation, the authors also investigated agencies that have encountered setbacks in developing recycled water projects. The following section summarizes their observations to date about the key elements that enable agencies to collaborate successfully to implement water reuse.

3.1. Strong drivers overcome legal and political obstacles

Severe water management problems with potentially dire consequences can inspire agency partners to join forces. With some notable exceptions, communities with ample surface water that are able to treat wastewater inexpensively rarely work together to invest in robust water reuse programs. By contrast, agencies in water-stressed areas that discharge into sensitive receiving streams often share common drivers.

One coastal agricultural area in the Western United States experienced such a driver when sinking groundwater levels exposed the entire region to the threat of seawater intrusion. This crisis brought together local water and wastewater agencies, who engaged a diverse array of agricultural and urban stakeholders. Working together, they created an ambitious program to reuse virtually all the effluent from the wastewater treatment plant for agricultural irrigation, reducing the stress on local groundwater supplies. Subsequently, the community is now combining agricultural discharge water, municipal wastewater, and stormwater and treating it to a quality suitable for groundwater injection. By persuading the community to embrace concerns about future shortages, public officials were able to successfully implement these approaches. (Smith, 2020)

On the other hand, two agencies managing water and wastewater in one urban area surveyed were unable to overcome challenges to reuse primarily because they were not exposed to pressures related to water supply or wastewater discharge. The wastewater agency, which has the ability to treat effluent to standards suitable for non-potable use, is located less than 5 km (3 mi) from an industrial complex that includes a large oil refinery. Although the refinery could use recycled water, the water and wastewater agency could never agree to work together to build the pipeline needed to convey the water, despite decades of discussions. The community is in an area generally described as “water short,” but the water agency has historic access to an abundant supply of fresh water which it provides at low cost to customers in its service area. Meanwhile, the wastewater agency is able to meet discharge limits with only secondary treatment, and would incur additional cost to manufacture recycled water for industrial use. In the absence of a compelling reason, the agencies have not resolved the economic or operational issues associated with serving recycled water to the industrial park.

Even where the need to augment water supplies and reduce discharge is apparent, political support may vary over time. In Los Angeles, California (USA) for example, local activists have pushed the City to increase reuse of the City’s wastewater, both to enhance regional sustainability and to protect Santa Monica Bay. Following completion of several projects in the 1990s, however, political support waned in the face of backlash against water reuse characterized as “toilet to tap.” Public and political support for recycled water has subsequently reemerged more strongly than ever with current Los Angeles Mayor Eric Garcetti’s plans to recycle 100% of the City’s wastewater by 2035. (Garcetti, 2019; Harris-Lovett & et al., 2015)

3.2. Strategies for overcoming economic challenges

Water reuse projects can be expensive, especially compared to traditional water supplies. They may not, however, be more costly than other new supply options, especially those that require significant capital investment such as new reservoirs. To remain fiscally sustainable, water agencies that invest in reuse need to be able to recover the cost through their rates. Cost recovery is challenging, not only because the cost of reuse may be relatively high, but also because the beneficiaries of the reuse water may not be directly served by the utility bearing the expense. As a case in point, while the regional wastewater utility may bear the brunt of the cost of reuse, potable water customers may appreciate significant benefit from the project.

Cross subsidies across agencies may be entirely justified by the economic principle of "beneficiary pays." However, institutional arrangements and related written legal arrangements may be needed to transfer funds from one utility to another. The agreements may include establishing contracts, joint power authorities, or other legal agreements to create a fiscally-based "virtual one water utility" by forging clear, enforceable terms across separate entities.

There are numerous examples of cost allocation and revenue sharing agreements if agencies have the political vision to make it so. In California, for example, investor owned water utilities regulated by the state's Public Utility Commission (PUC) can now recover the cost of reuse from all ratepayers, including those who do not have access to recycled water. Such cross-subsidies across accounting centers were not previously allowed, but have been justified on the basis that the benefits of reuse accrue to all ratepayers. (CPUC, 2009; CPUC, 2014). As another example, two southern California agencies successfully formed a Joint Powers Authority (JPA) enabling them to work with several other local water and wastewater agencies acting as a single "virtual" utility. Deploying the JPA as an organizational and accounting structure, costs and water were allocated across the numerous individual entities according to agreed upon terms. The JPA also facilitated access to various governmental grants to help subsidize the expense of the large and very successful water reuse program.

3.3. Regulations can inhibit or promote water reuse

State and federal regulations can stimulate agencies to work together, or erect barriers to their collaboration. In all cases utilities must engage with regulators to ensure that all parties understand the rules. Stricter regulations on water use and wastewater discharge have on many occasions indirectly influenced local agencies to pursue water reuse. Although the regulations did not specifically require the agencies to recycle water, the price of meeting more stringent discharge requirements was high enough that, given its additional benefits, water reuse became cost-effective. For instance, when one urban wastewater agency was required to reduce its inshore discharge to preserve endangered species habitat, the cost of reuse was about equal to the least cost alternative (a long outfall). Adding the value of recycled water as a supply tipped the balance in favor of reuse, and the wastewater agency engaged with local water utilities to develop the project. In another instance, more stringent mass loading limits designed to protect a bay near a large urban area from nutrient pollution put strict limits on both wastewater discharge and stormwater runoff. This allowed the regional wastewater agency to propose effluent reuse to surrounding cities as an alternative to the expense of each city individually implementing advanced treatment of stormwater.

Regulations designed to protect public health sometimes prevent appropriate uses of recycled water. While water reuse has been practiced in the western US state of Colorado for over 50 years, irrigation of food crops of any kind was strictly prohibited. While Regulation 84 allowed agricultural irrigation with recycled water, it specifically excluded "crops produced for direct human consumption, crops where lactating dairy animals forage, and trees that produce nuts or fruit intended for human consumption." This exclusion inhibited the use of recycled water in many urban settings, especially in community gardens which allowed city dwellers (including schools) to grow crops for personal consumption. (Sheikh, 2015) In 2013, water utilities and advocates for urban gardens worked together to modernize Colorado's recycled water regulations and in 2018 an overwhelming majority of the Colorado legislature passed HB18-1093 allowing the use of recycled water as an irrigation source for edible crops beginning in January 2020. (State of Colorado, 2018)

Conversely, regulations designed to protect public health can incentivize use of recycled water if designed appropriately. Water and wastewater agencies may be unwilling to work together when uncertain how regulations will be interpreted in the future. To encourage water recycling, California set statewide permitting standards for both categories of indirect potable water use (groundwater augmentation and reservoir augmentation) and is in the process of developing standards for direct potable reuse (raw and treated water reuse). These statewide public health standards have encouraged local agencies to work together with some assurance their projects can be permitted in a reasonable amount of time, reducing the risk that local permitting authorities might independently determine under what conditions a permit might be issued. These standards have increased the number of agencies developing plans for water recycling in Southern California and vastly expanded the volume of water to be recycled in the coming decade. (Marcus et al., 2020)

Brine disposal presents an additional regulatory challenge in many settings. Reuse programs relying on membrane technologies generate brine residuals that need to be properly managed. Where wastewater discharge flows are reduced as a result of diverting effluent to reuse, there is less discharge water available to dilute the brines to environmentally acceptable levels. This constraint on the ability to manage brine residuals in a manner consistent with regulatory standards can be a significant roadblock to reuse projects. In southern California, several utilities were able to work together to develop and share a brine line that blends reuse treatment residuals with other available wastewater and stormwater flows to enable environmentally compliant discharge to a suitable ocean outfall location. This collaboration across multiple utilities and municipal jurisdictions provides a mutually beneficial solution to what otherwise would have precluded successful water reuse programs. (Archuleta, 2014; Raucher, 2006)

3.4. Taking care of the technical details

As noted in Table 2, technical issues like the quality and quantity of recycled water to be delivered must be addressed by agencies collaborating to design, build and operate a recycled water system. In addition to measurable characteristics like pressure and flow rate and chemical and biological constituents in the water, partnership agreements should specify which agency is responsible for identifying and repairing leaks and breaks, and within what period of time.

When one agency purchases water from another, the parties must negotiate a price that reflects both the contribution of the wastewater agency in treating the water to reusable standards and the water agency's ability to deliver it to the customer. In some US states, water agencies have exclusive rights to supply water within their service areas and wastewater agencies may be prohibited from selling recycled water directly to customers. In that case, the wastewater agency may need to discount recycled water so that the final cost to the customer (including the water agency's markup) is not greater than the cost of potable water.

Liability issues for unplanned consequences frequently complicate interagency agreements. In addition to responsibility for pipe breaks noted above, agencies must agree upon who is responsible for complying with various regulations. Doubt about how the regulations will be interpreted and the compliance standards that may be in effect further exacerbate this problem. For example, in one large coastal US city, plans for a major potable water reuse project stalled because of uncertainty about how the discharge of reject brine from membrane treatment of recycled water would impact the receiving stream, and who would be liable if the resulting effluent failed to meet discharge requirements.

When two or more public agencies collaborate on a reuse project, they must work together to coordinate public outreach and ensure they convey to the public the same information about the safety, value and benefits of recycled water. Some agencies find it useful to "brand" the recycled water program so that public communications all have a similar identity distinct from the participating utilities. Other times the water supply agency takes the lead on communication due to its longstanding relationships with its customers. In either case, coordinated messaging has been shown to increase both public acceptance and compliance. (Crook, 2012)

3.5. The importance of vision and the role of the "champion"

All successful projects are borne of vision. In one example, as far back as the 1970's the managers and elected officials responsible for two large southern California water and wastewater utilities could foresee the benefit of water reuse. Seawater intrusion threatened the region's groundwater supplies, while their ability to discharge wastewater was constrained by increasingly stringent ocean discharge standards. Having identified water recycling as the solution to these problems, they were able to design, build, and operate what is now the world's largest indirect potable reuse groundwater augmentation project. (Mellen, 2018) Their ability to conceive of this approach and pass that vision to successive generations of agency leaders was a key to their success.

The values inherent in the agency's vision are often embodied by an individual or small group who keep the momentum going through inevitable challenges. These "champions" provide the tenacity needed to implement projects in the long run. As an example, one large East Coast agency faced increasingly strict nutrient limits while stormwater regulations required adjacent communities to reduce nutrient loadings from runoff and over-pumping threatened local groundwater supplies. Removing nutrients from stormwater flows would have cost over $3 billion USD, without solving either of the other problems. The wastewater agency manager recognized that repurposing highly treated effluent from the treatment plant for groundwater recharge addressed all three issues by decreasing the total load of nutrients from the plant. The manager drew on his experience and connections as a municipal public works director to invite local cities to resolve their individual challenges more effectively by treating the district's effluent to strict recharge standards, replenishing the region's depleted groundwater basins and reducing the impact of local stormwater at a fraction of the cost. His leadership inspired other managers to champion this strategy, which the local community also adopted.

4. NEXT STEPS

The authors will further investigate selected programs and add case studies. The authors will also test a number of hypotheses concerning the key influences on interagency cooperation, including the following:

1. In every successful program, there is at least one visionary leader who sees beyond jurisdictional limits and brings people together.
2. A "beneficiary pays" approach is more likely to result in a successful relationship.
3. Written documentation and enforceable agreements that identify the interests of all parties support successful projects.
4. Interagency agreements need to be recalibrated as programs mature and community needs evolve.

These results will be shared through workshops and webinars with a cross-section of agency staff and officials whose viewpoints will be integrated in the project report. The ultimate goal is to develop a suite of successful strategies, best practices and sample agreements that will help communities work together more confidently to implement recycled water projects.

This paper is dedicated to our colleague, Dr. Bahman Sheikh (1938-2020), whose vision and leadership were instrumental in its development.

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