Speaker notes from Yurie Shirakawa Keynote Presentation “Domestic Wastewater Management and the Johkasou System in Japan” presented at 2026 NOWRA Mega-Conference, October 26, 2026

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Good morning, everyone. My name is Yurie Shirakawa, from the Japan Education Center of Environmental Sanitation. Thank you for the opportunity to speak at this opening session, and my special thanks to Chris and Tom of NOWRA. It is a great honor to be here.

Today I will introduce domestic wastewater management and the johkasou system in Japan: the road from night soil recycling to on-site treatment as a national system. I hope you will enjoy the story of a small island country.

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First, a disclaimer. The materials presented today represent my own opinions and do not reflect the opinions of NOWRA.

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Before I begin, a few words about Japan. Japan is an island nation off the east coast of Asia, about the size of California, with 123 million people: a third of the US population on four percent of its land. Seventy percent of that land is mountains and forest, so people and houses are crowded into the rest. We also get twice as much rain as the US.

Tokyo is 9,400 kilometers west of Denver and fifteen hours ahead. Please keep this geography in mind: small lots, dense settlements and abundant water are the background to everything about the johkasou.

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A brief introduction to my organization, JECES. We are a public interest foundation in Tokyo, founded in 1966. We have four lines of work: training, as the designated training body for the national Johkasou Operator and Installation Worker courses; national examinations for those two qualifications; testing and research, including surveys commissioned by the Ministry of the Environment; and international cooperation, including an annual workshop with Asian countries. Today's talk is based on this work.

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Here is the outline. Why Japan needed a Johkasou Act; what the Act regulates; the structure and performance of johkasou; treatment coverage; how installation is subsidized;

how municipalities choose between collective and individual treatment; and finally what this may mean for the US.

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Section 1: why Japan needed a Johkasou Act. I will follow the story from the time when night soil was a resource, through urbanization and flush toilets, to the Act of 1983.

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Until the mid-20th century, human excreta collected in Japanese cities was sold to farmers as fertilizer. In Edo, today's Tokyo, collection was an organized trade with routes, contracts and prices. It was a closed nutrient loop: city to farmland, farmland to food, food back to the city. Urban sanitation was kept by an agricultural market, not by regulation. That is why Japan never had a sanitation crisis of the European type; our crisis came later, from a different direction.

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Urbanization broke that loop. After the war, chemical fertilizer replaced night soil, and farmers stopped buying it. Population concentrated in cities, and the volume collected exceeded what farmland could absorb. Collection and disposal became a municipal public health problem, a public cost. Municipal night soil treatment plants were built under waste legislation, and handling excreta moved from a private trade to a public service.

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Flush toilets then turned this into a liquid problem. Under the "flush toilets for 100 million" program, flush toilets reached ordinary households. Where there was no sewer, the wastewater had to be treated on site, and the Building Standards Act required a treatment facility wherever a flush toilet was installed.

This is how the tandoku-shori johkasou appeared. I will call it the Old Type Johkasou: a unit that treats toilet wastewater only. It spread rapidly from the 1960s. Outside sewered areas, the Old Type Johkasou was the price of the flush toilet.

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But gray water still went straight to the river. The Old Type Johkasou treated toilet wastewater only; kitchen, bath and laundry water was discharged untreated. Gray water carries about two-thirds of the household BOD load, so an Old Type unit discharges roughly eight times the load of a unit that treats everything.

That unit is the johkasou of today, gappei-shori johkasou, which treats toilet wastewater and gray water together. From here, when I say "johkasou", I mean this current type.

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Why was a dedicated law needed? Before 1983, johkasou were regulated only in fragments: structure under the Building Standards Act, sludge under waste legislation. There were no rules on how units were installed or maintained, or who could do that work. Field performance fell far short of design performance, odor complaints poured into public health centers, and the Old Type Johkasou became a social problem. The answer was one statute covering manufacture, installation, use, O&M, desludging, businesses and qualifications.

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Article 1 states the purpose: appropriate The Johkasou Act was promulgated in May 1983, and registration, permission and national qualifications began. Through the 1980s and 1990s, subsidies and administrative guidance shifted from the Old Type to today's johkasou, and in 2000 new installation of Old Type Johkasou was prohibited.

Treatment of night soil and gray water, to conserve public water quality, the living environment and public health. So the user who discharges the wastewater has a duty to protect the environment, and therefore a duty to carry out O&M and desludging.

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Meanwhile, the night soil collection business was disappearing. Night soil collection was a service provided by private contractors licensed by the municipality, with vacuum trucks, depots and crews.

In sewered areas, every house that switched to a flush toilet was one house no longer collected. The response was the 1975 "Gotoku-ho", the Act on Special Measures concerning the Rationalization of General Waste Disposal Businesses accompanying the Development of Sewerage Systems.

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The contractors could not simply close. They had to keep serving the remaining houses right up to the day of sewer connection. And vacuum trucks and depots cannot be redeployed to anything else.

This is where a public response was needed

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This is how the Gotoku-ho works. The municipality prepares a rationalization business plan with the consent of the businesses concerned, and obtains the approval of the prefectural governor.

Alternative work was provided: johkasou desludging and O&M, night soil and sludge treatment facilities, sewer pipe maintenance, rural community sewerage O&M, and other work outsourced by the municipality.

In addition, there were financial measures, such as compensation for vehicles and equipment that could no longer be used and support for the cost of converting the business, and employment measures, such as vocational retraining, help in obtaining qualifications, and job placement.

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Why does this matter for johkasou? Because much of the alternative work was johkasou desludging and O&M. The crews, the vehicles and the local coverage moved from night soil collection into johkasou service.

So when the Johkasou Act created O&M duties in 1983, the service industry to carry them out already existed. Japan did not build an O&M industry from nothing; it redirected an existing one.

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Section 2: what the Johkasou Act regulates. One law covers the whole life cycle, from the factory to the annual legal inspection.

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Five stages, one law. Manufacture: type approval by the Minister of Land, Infrastructure, Transport and Tourism. Installation: notification to the governor, registration of the installer, and an Installation Worker on site. Use: the rules the user must observe. O&M: operation and maintenance and desludging to technical standards. Inspection: the legal inspection after installation and the annual legal inspection, by a designated agency.

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Here is the whole framework on one page. The manufacturer obtains type approval. The installer is registered with the governor and keeps an Installation Worker on site. The manager notifies the start of use and receives the Article 7 inspection. O&M is done by a contractor employing a Johkasou Operator, desludging by a contractor permitted by the

mayor, and every year the designated agency carries out the Article 11 inspection and reports to the governor.

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Three instruments hold the system together. Technical standards: effluent, structure, and the standards for construction, O&M and desludging. Qualifications: the Installation Worker, the Johkasou Operator, the Technical Supervisor, the Desludging Technician and the Inspector. And administrative supervision: registration and permission, reports and on-site inspection, advice and orders. A standard with nobody qualified to apply it, or a qualified person with nobody to check the work, would each fail on its own.

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The duties fall on the owner and the user. The Act created the "johkasou manager": the owner, the occupier, or anyone with authority over the unit. The manager must carry out O&M and desludging, and must receive the post-installation and the annual legal inspections. The work can be entrusted to registered contractors, but the legal responsibility stays with the manager.

One note: PE here means nin-sou, a design capacity in persons calculated from building use and floor area, not the organic-load population equivalent used in the US.

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A Technical Supervisor must be appointed for units of 501 PE or more, and start of use, change of manager and discontinuation must be notified. The diagram shows the structure: the manager entrusts O&M and desludging to contractors, but requests the legal inspection in their own name. The work can be entrusted; the responsibility cannot. This principle is the foundation of the Japanese system.

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The rules of use: what the household must do. These are prescribed by Ministry of the Environment ordinance. Do not pour oil, solvents, medicines or disinfectants into the drain. Do not flush non-degradable items. Do not switch off the blower, even when the house is empty. Keep the manhole covers closed, undamaged and accessible. Much of the gap between design performance and field performance starts here.

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Operation and maintenance. The purpose is to keep normal treatment performance. It means inspection, adjustment and the repair that goes with them: sludge and scum accumulation, water quality, mechanical equipment, and replenishment of disinfectant.

The frequency is at least three times a year, varying with size and process, and it is carried out by a registered contractor employing a qualified Johkasou Operator.

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Desludging. The purpose is to recover the capacity that accumulated sludge has taken away: extraction of sludge and scum, conditioning of the tank contents, and washing of the units. At least once a year, by a desludging contractor permitted by the mayor. The sludge is treated at the municipal night soil treatment facility.

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Two legal inspections by a third party. The Article 7 inspection, three to eight months after start of use, confirms that construction and initial performance are sound. The Article 11 inspection, every year, confirms that O&M and desludging are actually done and that performance is maintained. Both are carried out by an agency designated by the governor, independent of the contractors. The three functions cannot substitute for each other.

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Here are the four functions side by side: the Article 7 inspection by the Inspector, O&M by the Johkasou Operator three or more times a year, desludging by the Desludging Technician at least once a year, and the Article 11 inspection by the Inspector once a year. Each party is different.

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And here is the reality of implementation in FY2024. The Article 7 inspection, tied to installation, reaches 97 percent. But the recurring duties fall away: O&M 74.5 percent, desludging 65.9 percent, and the annual Article 11 inspection only 50.9 percent of all units. For johkasou alone, excluding the Old Type, it is 67.2 percent; the Old Type units pull the average down.

Even with a dedicated Act, implementation does not reach 100 percent. Raising these rates is one of Japan's standing challenges.

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What does the annual inspection find? In FY2024, about 2.1 million Article 11 BOD tests were made on household-size units rated for 20 milligrams per liter. 85 percent of the results were at or below 20, and the mean was 11.7 milligrams per liter. The other 15 percent are why the inspection exists: those units are flagged and followed up. The annual inspection is not only a compliance check; it is the national dataset that shows the standard is actually met in the field.

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Who is qualified to do what. The Installation Worker supervises construction on site. The Johkasou Operator carries out O&M; about 42,000 nationwide. The Technical Supervisor is required for units of 501 PE or more; about 8,000. The Desludging Technician has the skills for desludging. And the Johkasou Inspector carries out the legal inspections; about 1,500 are registered.

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With the 2000 amendment, new installation of Old Type Johkasou was prohibited from April 2001. Existing units were renamed "deemed johkasou", and their owners were placed under a duty of effort to convert to a johkasou. About 3 million deemed johkasou are still in service today. This is one of the major challenges Japan faces.

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Four pressures on the system today. Conversion from Old Type to johkasou is slow: replacement is paid for by the household, with only a duty of effort. Units are aging: many installed in the 1970s and 80s are over 40 years old. Users are declining: rural depopulation shrinks the revenue base of local contractors. And the duties are not fully met, as we saw on the implementation rates.

The 2019 amendment allows the governor to designate a deemed johkasou that poses a risk to the living environment and to issue advice and orders.

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The 2019 amendment, in force from April 2020, gave a legal basis to public johkasou, installed and managed by the municipality. Prefectures must now keep a johkasou ledger. Johkasou councils bring municipalities, contractors and inspection agencies together, and Johkasou Operators must take periodic training. The direction is from regulating each unit towards managing the whole stock of units in an area.

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Section 3: structure and treatment performance. The johkasou itself, the performance evaluation system, and what it made possible.

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A johkasou treats toilet wastewater and gray water together in a single tank. Small units are 5 to 50 PE, up to 10 cubic meters a day; this is the domestic range. Medium and large units are 51 PE and above. The discharge point is usually a roadside ditch or a small stream a few

meters from the house. Because the receiving water is small and close, effluent quality is not an abstract standard. It is visible to the neighbors.

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Effluent quality and performance requirements. BOD of 20 milligrams per liter or less is the statutory standard, and BOD removal of 90 percent or more is also required. Where the receiving water needs it, nitrogen and phosphorus targets are added. The standard must be met under real household conditions: intermittent flow, morning and evening peaks, near-zero flow at night, and long absences.

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This is how a new product reaches the market: a johkasou test on an actual unit, performance evaluation by a designated body, MLIT approval of the structural method, and type approval for factory-made units. Type approval is renewed every five years, and imported units need the same approval.

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The test reproduces a household, not a laboratory. It is run on an actual unit over a long period, with real domestic wastewater, hourly flow variation, morning and evening peaks, shock loads, no-load periods and restart after absence. Water quality is measured across the whole cycle. This is why a small unit at a single house can be expected to reach its design performance in the field.

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From a prescribed drawing to a proven result. In the structure-example type, a ministry notification prescribes the tank arrangement and chamber volumes, and compliance is shown by building to the drawing. In the performance-evaluated type, the manufacturer proposes any process, and compliance is shown by demonstrating effluent quality in a test. Development moved from following a drawing to proving a result, and competition shifted to process design.

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A smaller reactor means a smaller site. The chart shows the tank volume of 5 PE units: performance-evaluated models are 50 to 80 percent of the structure-example type, and the most compact ones are about the size of an Old Type unit. Less excavation, a narrower working space, a lighter crane. Downsizing is not only a cost question; it decides whether converting from an Old Type Johkasou is physically possible on a given lot.

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One common target, several processes. Because the requirement is written as effluent quality, different processes compete on equal terms. Selection depends on influent, the need for nitrogen or phosphorus removal, available area, power and access for O&M. The O&M points differ from process to process, so the Operator must know which process is in front of them before opening the lid. The technology is diverse, so the qualification has to be general.

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Three representative structures. Anaerobic filter plus contact aeration is the standard small unit: simple, robust and understood by every technician. Carrier fluidized bed or biological filtration achieves a higher loading in a smaller tank. Circulation plus denitrification is advanced treatment for nitrogen removal, for lakes and enclosed bays.

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Section 4: domestic wastewater treatment coverage. Four public systems, one shared indicator, and a persistent gap.

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Four systems, three ministries. Sewerage under the Ministry of Land, Infrastructure, Transport and Tourism; rural community sewerage under the Ministry of Agriculture; johkasou under the Ministry of the Environment; and small community plants, counted with johkasou. Different ministries and funding routes, but one indicator: the domestic wastewater treatment coverage rate, published jointly every year.

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National coverage at the end of FY2024: sewerage 81.8 percent, johkasou 9.5 percent, and 93.7 percent in total. About 820,000 people are served under the public johkasou program. The remaining 7.8 million people use Old Type Johkasou and vault toilets.

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The gap is a question of municipality size. In cities of one million or more, coverage is 99.8 percent; in municipalities under 50,000 it is 84.5 percent. Conversely, the johkasou share rises from 0.3 percent in the largest cities to 21.8 percent in the smallest. Of 1,719 municipalities, 1,231 are in that under-50,000 group.

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Where are the remaining 7.8 million people? In small municipalities: mountain valleys, coastal settlements and scattered farmhouses, with long distances and few houses.

Population is falling fastest exactly where the gap is largest, and johkasou already serves 21.8 percent of the population there. The remaining task is not a scaled-down version of the sewered city. It is a different problem, and it needs a different tool.

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Section 5: how johkasou installation is subsidized. The national grant, the municipal programs, and the share the household still pays.

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Two subsidy routes since the 1980s. On the left, the individual-installation type, since 1987, the norm: the household buys and owns the unit, the municipality pays a fixed subsidy, and the national grant covers one-third of that subsidy. The owner becomes the johkasou manager and pays for O&M, desludging and inspection.

On the right, the municipal-installation type, the public johkasou, since 1994: the municipality installs and owns the unit like a sewer, and the household pays about 10 percent of the cost plus a monthly fee. In the FY2025 survey, 158 municipalities managed about 119,000 public johkasou. It is the exception, not the rule.

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Who pays for a standard 5 PE unit? In the Kitakyushu example, installation costs about 5,600 dollars. The subsidy base is 40 percent: the national grant pays one-third of that, the municipality two-thirds. The household pays the remaining 60 percent, about 3,400 dollars.

Why public money for a private tank? Because clean public water is a public benefit, the purpose written in Article 1. The household gets the toilet; the public gets the clean river.

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Converting an Old Type Johkasou earns extra support: 800 dollars for removing the old tank, and up to 2,000 dollars for reconnecting the kitchen, bath and laundry drains to the new unit. In total, a conversion can receive about 2.3 times the amount for a new house. The money follows the policy priority.

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What the subsidy covers, and what it does not. Installation is subsidized: a one-off payment, applied for before construction. O&M, desludging and the legal inspection are paid by the user: three or four visits a year, desludging once a year, the Article 11 inspection once a year, about 430 dollars a year for a 5 PE unit, with no routine subsidy. The subsidy

buys the tank; the Johkasou Act keeps the running costs, and the responsibility, with the user.

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How much does the user pay every year? This is from the Ministry's FY2025 survey, which we JECES carried out. For a 5 PE unit: O&M about 120 dollars, desludging about 174, the Article 11 inspection about 34, and blower electricity about 100, a total of about 430 dollars a year, or 36 dollars a month. Desludging is the largest item, about 40 percent. The user pays each contractor directly, about 8 percent of the installation cost every year.

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The same survey has run since 1998, and the 5 PE total has stayed almost flat in nominal yen: about 435 dollars then, about 430 now. Contractor prices are set in a competitive local market; the small rise since 2014 is mainly electricity. A user-pays system is only sustainable if the price stays affordable. Twenty-five years of flat prices is the evidence that it has.

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Section 6: collective or individual treatment. How Japanese municipalities decide, and why the answer is changing.

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Johkasou sits within waste legislation. Night soil and johkasou sludge are general waste, and the municipality is responsible for treating them. Every municipality must prepare a general waste management plan, and within it a domestic wastewater treatment basic plan. That plan decides which area is served by sewerage, by rural community sewerage, or by johkasou, and by when.

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Two ways to treat the same wastewater. Collective treatment is one plant plus a pipe network; the cost is dominated by the pipes, and it gains from density. Individual treatment is one johkasou per house; the cost is proportional to the number of houses and indifferent to density. And there is timing: a collective system serves nobody until the network is finished, while a johkasou serves a house on the day it is installed.

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House spacing decides the pipe cost. Pipe length per house is roughly the distance between houses. As houses spread out, the collective cost per house rises steeply, while the johkasou cost stays flat. So the two lines cross.

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That crossing point is the critical inter-house distance. Below it, collective treatment is cheaper; above it, johkasou is cheaper. This comparison is the standard screening step in prefectural and municipal plans. It is not a single national number: it depends on terrain, ground conditions, pipe depth, pumping, subsidy rates and the period compared, and operation and replacement costs belong in the comparison, not only construction.

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Depopulation is changing the answer. Plans drawn during population growth assumed the sewered area would fill up with houses. With fewer houses, the cost per house rises after the network is built, and the network cannot be un-built. The choice is not made once; it is revisited as the population changes.

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Many municipalities have reviewed their plans, reduced the planned sewerage area, and reassigned the outer areas to johkasou. Fuji City in Shizuoka is one example: the sewerage planning area was cut from 6,573 hectares to 5,991 across two plan revisions. Aging sewer assets are pushing the same reassessment in areas already served.

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Section 7: relevance to the US context. The differences between on-site systems in the US and in Japan.

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Johkasou and US onsite systems side by side. Treatment principle: septic tank with drainfield or an ATU, versus Japan's factory-built package unit, the same family as an ATU. Effluent quality: NSF 40's CBOD 25 and TSS 30, versus Japan's statutory BOD 20, with total nitrogen 20 or 10 for nitrogen-removal types. Performance evaluation: the 26-week NSF test versus Japan's performance evaluation test and type approval.

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Siting and permitting: state or county permits in the US; uniform national rules and the Article 7 inspection in Japan. The big differences are O&M and qualifications. In the US, maintenance is the owner's responsibility, and service contracts are required only for some

systems in some states. In Japan it is statutory: O&M by a qualified Johkasou Operator, desludging, and the annual legal inspection are all mandatory, under national qualifications.

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To summarize. Japan did not choose johkasou instead of sewerage; it uses both, allocated by area. The johkasou works because the Act ties together a standard, a qualified person and an inspection, and the performance evaluation system is what allows a small on-site unit to be trusted. The remaining gap sits in small, dispersed, shrinking municipalities, and the right answer changes as population changes. Public money support to buy the tank; the user pays to keep it working. And even with the Act, not every user contracts O&M, desludging and inspection.

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Thank you very much for your attention. My contact details are on the slide. I would welcome any questions.