# RFI

**Request For Information**

City of Los Angeles
Department of Water & Power

# For
# Green Hydrogen Pathways for Supporting 100% Renewable Energy

**RFI Number: 8.5.21-Power-SAL**

**Release Date: 8/5/2021**

**Responses Due: 10/7/2021**

# REQUEST FOR INFORMATION (RFI) 8.5.21-POWER-SAL

# CITY OF LOS ANGELES GREEN HYDROGEN PATHWAYS FOR SUPPORTING 100% RENEWABLE ENERGY

## 1. INTRODUCTION

The Los Angeles Department of Water and Power (LADWP) is requesting information from interested parties experienced in the planning, design, and deployment of hydrogen and/or hydrogen infrastructure. Specifically, LADWP is interested in technologies related to four main areas of hydrogen: production, transportation, storage, and electricity generation, all of which are to support the future electricity-generating needs of the City of Los Angeles. LADWP is also seeking information on best practices and technologies in regards to hydrogen that advances LADWP's commitment to safety and environmental stewardship. Information gathered from this Request for Information (RFI) will assist LADWP in its continued development of clean-energy strategies, programs, and investments.

In March 2021, LADWP released the findings of a three-and-a-half-year-long study with the United States National Renewable Energy Laboratory demonstrating that a 100% renewable grid is achievable, affordable, and reliable for Los Angeles. The study showed that green hydrogen may serve an important role in supporting the integration of significant renewable energy capacity within the LA Basin ("in-basin"). Through this RFI, LADWP seeks to better understand the opportunities and challenges associated with green hydrogen in meeting its clean energy future objectives. Specifically, LADWP's objectives are to:

1. Maintain resource adequacy that supplies reliable electricity to the City of Los Angeles at a competitive rate;
2. Provide a carbon-free alternative to the predominantly fossil fuel-based electricity generation in the LADWP service territory;
3. Reduce LADWP's carbon footprint;
4. Enhance operational system reliability, resilience and cost-efficiency;
5. Utilize LADWP's existing in-basin infrastructure to the extent possible to help reduce the initial capital expenditures;
6. Provide economic opportunities and job creation, while prioritizing existing workforce safety, retention, training, and development.

This RFI is issued with the intent to survey the industry, to obtain information on the types of solutions and capabilities available with respect to pathways for green hydrogen-based electricity generation that are commercially available or under development, and to solicit additional guidance, input, new ideas, and best practices which may be used in the preparation of a Request for Proposal (RFP).

To fully comprehend the information contained within a response to this RFI, LADWP may request further clarification in the form of verbal communication by telephone, written communication, electronic communication, a presentation, an interview, and/or a site visit at no cost to LADWP.

Responses should include information and recommendations of best practices for the development of LADWP's capabilities and pathways for in-basin green hydrogen-based electricity generation. All responses should be concise and focused on one or more of the technologies of interest. LADWP will use the information generated as a result of this RFI to develop a green hydrogen roadmap that is in the best interest of the City of Los Angeles. This RFI shall not be construed as an RFP or an obligation on the part of LADWP. In addition, LADWP does not intend to award a contract on the basis of this request or otherwise pay for the requested information, but may utilize any or all of the provided information in determining potential green hydrogen-related opportunities for future bid or RFP considerations.

## 2. BACKGROUND

This section provides information on the Los Angeles 100% Renewable Energy Study[1] for context on LADWP's potential needs for hydrogen-based electricity generation and the approximate quantities of hydrogen required. This section also describes LADWP's recently announced goal to be 100% carbon-free by 2035, LADWP's expectations on the potential hydrogen production methods, and the technologies of interest in regards to hydrogen.

### A. LA100 STUDY

As LADWP retires up to 1,661 megawatts (MW) of once-through cooling (OTC) units by the end of 2029, LADWP has identified a need to build additional long-duration capacity within the Los Angeles Basin to avoid widespread blackouts during transmission outages due to wildfires, transmission line maintenance and upgrades, and other contingencies. In partnership with the National Renewable Energy Laboratory (NREL), the Los Angeles 100% Renewable Energy Study ("LA100" or "LA100 study") identified investment pathways that would allow the City of Los Angeles to achieve a 100%-renewable-energy portfolio no later than 2045.

One of NREL's findings is that for LADWP to maintain a reliable power supply, its generation fleet needs an appreciable amount of firm capacity, also referred to as dispatchable capacity. NREL defined firm-capacity resources as generation resources whose capacity credits (i.e., dependable capacity ratings) remain constant, regardless of customers' demand patterns and the particular mix of technologies deployed on the grid. Firm-capacity resources can generate electricity on demand for uninterrupted periods of days to weeks. Although all the LA100 scenarios deploy a substantial amount of wind and solar energy, these resources are variable and thus have a diminishing incremental capacity credit at higher levels of deployment. It is therefore cost-prohibitive to achieve 100% renewable energy using variable resources alone. Beyond cost considerations, NREL's analysis of renewable firm-capacity resources was also motivated by the need to address resource adequacy

[1] Cochran, Jaquelin, and Paul Denholm, eds. 2021. The Los Angeles 100% Renewable Energy Study. Golden, CO: National Renewable Energy Laboratory. NREL/TP-6A20-79444. https://maps.nrel.gov/la100/.

during critical transmission outages, which cut off substantial portions of the city's access to wind and solar energy outside the LA Basin.

NREL's capacity expansion model utilized in the LA100 study selects the least-cost, best-fit resources to meet capacity needs. Hydrogen combustion turbines (CTs), renewable CTs[2], and hydrogen fuel cells were identified as potential technology options that could serve the in-basin capacity needs. For the purposes of this RFI, the capacity and generation estimates from renewable CTs are effectively considered to be hydrogen-based.

NREL assumed that before 2045, hydrogen-based long-duration storage will use zero- or low-variable-cost generation to self-produce hydrogen fuel, which is then converted to ammonia and stored in tanks near the generation facility. NREL assumed that by 2045, a renewable-hydrogen market will have emerged, allowing LADWP to purchase hydrogen from the market. The ammonia is assumed to be cracked to yield hydrogen, which is then used as fuel by CTs or fuel cells. NREL assumed that pure-hydrogen-based generation would not be a mature technology until 2030 and thus prohibited hydrogen CTs and fuel cells from the LA100 scenarios before this year, with the exception of phased-in hydrogen fuel at Intermountain Power Project (IPP). In NREL's LA100 scenarios, all the firm-capacity resources aside from geothermal plants are used infrequently, when customer load is high and while wind and solar output are low.

NREL identified the need for approximately 1,200 MW to 2,600 MW (depending on the load and scenario studied) of firm capacity to supplement the loss of OTC capacity by 2030. A need of approximately 1,700 to 4,300 MW is required by 2045. This RFI is meant to better understand the current and future capabilities of the broader hydrogen industry, and from there LADWP seeks to identify the role of hydrogen in achieving new in-basin dispatchable capacity.

Firms responding to this RFI need not be limited to the assumptions made in the LA100 study; rather, this information is meant to provide context on LADWP's projected need for in-basin hydrogen capacity.

## B. 100% CARBON-FREE BY 2035

On April 19, 2021, after the completion of the LA100 study, Mayor Eric Garcetti announced in the State of the City address that LADWP would adopt the goal to be 100% carbon-free by 2035. Mayor Garcetti also announced that LADWP would provide an energy mix that is 80% renewable and 97% carbon-free by 2030, and that the units at Scattergood Generating Station would transition to run on green hydrogen. To achieve green-hydrogen-based electricity generation at Scattergood prior to 2030, LADWP has provided additional estimates for the hydrogen capacity needs of Scattergood, supplementing NREL's data in the following subsection. These estimates are separate from the results of the LA100 study and are a product of internal preliminary analysis at LADWP.

[2] NREL defines "renewable CTs" as renewably fueled combustion turbines that are assumed to use a market-purchased renewable fuel, including but not limited to, biodiesel, biogas, ethanol, synthetic natural gas, and hydrogen.

## C. PROJECTED HYDROGEN NEEDS

This section summarizes NREL's findings regarding LADWP's projected hydrogen-based generation needs within the LA Basin. The estimates presented in this RFI are in the form of ranges that are reflective of the results from all nine LA100 modeling scenarios, each of which is based on assumptions that reflect uncertainty about the future. The hydrogen capacity identified for each scenario is thus heavily informed by these assumptions. These projected needs are subject to change, as LADWP refines its strategic plan toward achieving its goals of providing clean, reliable, low-cost electricity to the City of Los Angeles. Significantly more hydrogen fuel may be needed to sufficiently address outage conditions resulting from various contingencies.

Table 1 displays NREL's estimates for capacity of hydrogen-fueled CTs across the study's modeling years and for each in-basin generating station. In-basin hydrogen-based generation capacity is absent in 2025 and 2030. This is a result of NREL's assumption that pure-hydrogen-based generation would not be a mature technology until after 2030. LADWP is certainly interested in developing the capabilities for in-basin, hydrogen-based electricity generation before 2030, so long as the associated technologies mature, and hydrogen is available. LADWP encourages respondents to comment on whether or not their suggested solutions could be available earlier than 2030.

Table 2 shows NREL's estimates for hydrogen-related electricity generation across the study's modeling years and for each in-basin generating station.

**Table 1. Estimated Hydrogen-Based Capacity**

| Generating Station | MW of Capacity | | | |
|---|---|---|---|---|
| | **2025 and 2030** | **2035** | **2040** | **2045** |
| Harbor Generating Station | – | 257–543 | 543–548 | 548–902 |
| Haynes Generating Station | – | 762–1,488 | 831–1,448 | 831–1,552 |
| Scattergood Generating Station[3] | 0–616 | 188–616 | 188–616 | 188–616 |
| Valley Generating Station | – | 891–1,331 | 891–1,331 | 1,331–1,391 |
| Total In-Basin | – | 2,099–3,550 | 2,454–3,612 | 2,898–4,091 |

[3] The estimated MW capacities for 2025 and 2030, and the upper bounds for 2035, 2040, and 2045 are a result of internal analysis at LADWP and are separate from the results of the LA100 study. The estimated generation and fuel needs at Scattergood for 2025 and 2030 are to be determined.

### Table 2. Estimated Hydrogen-Based Generation (Annual)

| Generating Station | MWh of Generation[4] | | | |
|---|---|---|---|---|
| | **2025 and 2030** | **2035** | **2040** | **2045** |
| Harbor Generating Station | – | 4,950–34,623 | 16,999–498,133 | 19,336–363,065 |
| Haynes Generating Station | – | 6,645–9,815 | 32,009–53,254 | 28,180–351,080 |
| Scattergood Generating Station | TBD | 0–12,226 | 1,077–3,537 | 0–58,367 |
| Valley Generating Station | – | 0–12,304 | 38,720–87,354 | 4,346–38,796 |
| Total In-Basin | – | 11,595–68,968 | 88,805–642,278 | 51,862–811,308 |

Table 3 shows NREL's estimates for the annual quantities of hydrogen needed in metric tonnes across the study's modeling years and for each in-basin generating station. These quantities were calculated based on an assumed heat rate of 9.50 MMBtu/MWh for hydrogen-fueled CTs. The assumptions made for each of the scenarios, as well as any other modeling results, may be obtained directly from the LA100 study.

Table 4 provides the corresponding quantities of ammonia calculated directly from the estimated hydrogen quantities presented in Table 3.

### Table 3. Estimated Hydrogen Quantities (Annual)

| Generating Station | Quantities of Hydrogen (tonnes)[5] | | | |
|---|---|---|---|---|
| | **2025 and 2030** | **2035** | **2040** | **2045** |
| Harbor Generating Station | – | 414–2,894 | 1,421–7,302 | 1,616–30,348 |
| Haynes Generating Station | – | 555–820 | 2,676–4,451 | 2,356–29,347 |
| Scattergood Generating Station | TBD | 0–1,022 | 296–1,824 | 0–4,879 |
| Valley Generating Station | – | 0–1,028 | 91–3,237 | 363–3,243 |
| Total In-Basin | – | 969–5,765 | 4,482–16,814 | 4,335–67,817 |

[4] Significantly more hydrogen-based generation may be needed to sufficiently address outage conditions resulting from various contingencies.

[5] NREL assumed a heat rate of 9.50 MMBtu/MWh.

**Table 4. Corresponding Ammonia Quantities (Annual)**

| Generating Station | Quantities of Ammonia (tonnes) | | | |
|---|---|---|---|---|
| | **2025 and 2030** | **2035** | **2040** | **2045** |
| Harbor Generating Station | – | 2,317–16,207 | 7,957–40,891 | 9,051–169,952 |
| Haynes Generating Station | – | 3,111–4,595 | 14,983–24,928 | 13,191–164,341 |
| Scattergood Generating Station | TBD | 0–5,723 | 1,656–10,213 | 0–27,322 |
| Valley Generating Station | – | 0–5,759 | 504–18,125 | 2,034–18,160 |
| Total In-Basin | – | 5,428–32,284 | 25,101 –94,157 | 24,277–379,775 |

Appendix A provides a list of LADWP's in-basin generating stations along with each of the generating units' capacities.

### D. DESIRED HYDROGEN PRODUCTION METHODS

LADWP's objective is to source and utilize green, environmentally sustainable hydrogen for the purpose of electricity generation. LADWP will consider all potential pathways to demonstrate green hydrogen as a viable energy carrier at scale and for the purpose of developing the in-house expertise necessary to operate and maintain hydrogen infrastructure for hydrogen-based electricity generation.

### E. TECHNOLOGIES OF INTEREST

LADWP has identified four primary areas of technological interest that may be needed for the utilization of hydrogen as a fuel for electricity generation to serve the City of Los Angeles. These areas of interest are: (1) hydrogen production, (2) hydrogen transportation, (3) hydrogen storage, and (4) electricity generation, collectively referred to as "Technologies of Interest." LADWP seeks information on the Technologies of Interest, as well as best practices that advances LADWP's commitment to safety and environmental stewardship in a hydrogen energy economy. LADWP understands that it may not have captured all potential technologies, and most importantly, LADWP invites firms to respond to this RFI if it believes the technology suggested will assist LADWP with achieving its goal of sourcing in-basin hydrogen needs for electricity generation, regardless of the technology's capacity or size.

## 3. INFORMATION REQUESTED

This section contains the information requested from your firm for commercially available and under-development technologies that may assist LADWP in achieving hydrogen-based electricity generation. Proposed technologies and methods from your firm will be collectively referred to as the "Suggested Solution."

The first subsection contains general requested information regarding all Suggested Solutions. The following subsections contain specific questions regarding each Technology of Interest. The final subsection describes the information requested specifically related to safety and environmental stewardship.

LADWP requests that your firm provide the requested information from one or more of the subsections as applicable, based on the Suggested Solution's involved technologies, methods, and scope.

## A. GENERAL

Please provide answers and/or information to satisfy the following questions related to the production, transportation, storage, electricity generation, safety, and/or environmental stewardship that may be used in supporting the future electricity generation needs of the City of Los Angeles.

The requested information for all Suggested Solutions is as follows:

1. Provide the specific Technologies of Interest area(s) that your Suggested Solution addresses.
2. Provide a general overview of your Suggested Solution.
3. Provide a summary of how your Suggested Solution meets the objective(s) of this RFI.
4. Identify key advantages and features of your Suggested Solution.
5. Describe the process and the approach used to arrive at the Suggested Solution.
6. Describe the approach for forming the collaborative team that consists of various areas of expertise, including utilization of other firms and partnerships, that will be needed for developing the Suggested Solution.
7. Provide general project information as applicable, such as involved technologies, necessary partnerships, required resources, location, footprint, size (MW), existing/upgrade/new, and/or connection/delivery points.
8. Provide the anticipated environmental impacts and requirements for a full end-to-end lifecycle of the Suggested Solution, including but not limited to, greenhouse gas (GHG) emissions, NOx emissions, permitting, and other notable environmental impacts.
9. Provide information on the availability and/or level of development of your Suggested Solution.
10. Describe how resources under your Suggested Solution may be used or combined with other technologies or solutions.
11. Provide and describe any other new and emerging technologies that may be considered as potential Suggested Solutions as part of this RFI.
12. Provide a brief history of the technologies involved in your Suggested Solution, including but not limited to, previous applications, where it has been in use, how long it has been in use, etc.
13. Describe the nature and results of implementation at other locations (i.e., schedules, financing, costs, performance, length of service to date, measured results, project failures, lessons learned, etc.).
14. Describe the anticipated reliability of the Suggested Solution.

15. Does your Suggested Solution include the capability to supply hydrogen to one or more of LADWP's generating stations? If so, which one(s)?
16. Describe how the Suggested Solution could be incorporated into LADWP's facilities or operations.
17. Does your Suggested Solution require the addition and/or upgrade of infrastructure? If so, what upgrades would be required?
18. Provide information on potential funding opportunities from governmental entities or non-governmental entities for which the Suggested Solution would qualify.
19. Identify what regulatory requirements, permits, and/or related considerations are needed to implement the Suggested Solution.
20. Identify what operating considerations are necessary for the Suggested Solution to perform appropriately.
21. Describe the expected lifecycle of the Suggested Solution, including what steps are necessary at the end of life (i.e., replacement, renovation, upgrade, disposals, mitigations, etc.) and the associated costs.
22. Provide a timeline for project development to implement the Suggested Solution. If the Suggested Solution uses technologies not yet commercially available, provide a best-guess date or timeframe when such technologies will become commercially available.
23. Describe to what extent the performance of the Suggested Solution may be guaranteed.
24. Provide information on the expected effect of hydrogen embrittlement on your Suggested Solution and any countermeasures taken or recommended.
25. Provide information on how climate change and extreme weather events may or may not impact the Suggested Solution and the approaches and methodologies to combat such events (e.g., weatherization).
26. Provide all recommended safety procedures and hazard/risk assessments, including but not limited to, those related to fire, earthquake, accidental release, and catastrophic failure for the Suggested Solution.
27. Which raw materials may introduce supply chain risks that can affect commercial viability or continuity of service for your Suggested Solution?
28. Identify any other issues or considerations (e.g., new fire codes, other regulations, enhanced training, organization impacts, etc.) not otherwise covered that can assist LADWP in developing the requirements for the implementation of the Suggested Solution.
29. Describe the expected maintenance procedures required to keep the assets in operation until the end of life of the Suggested Solution, including inspections, regular maintenance, consumables, component replacement, major overhauls, etc., and the estimated operations and maintenance costs.
30. Provide information on established guidelines and/or procedures for conducting testing and commissioning.
31. Provide recommendations on potential partnerships and incentives that will help grow and leverage clean-energy jobs and the training of associated skilled personnel.

32. Provide information on your firm's proposed business relationship with LADWP as it relates to the Suggested Solution.
33. The following information requested pertains to labor and workforce development:
    i. What is the expected number of personnel required to operate your Suggested Solution?
    ii. Provide what type of training credentials, apprenticeship, and workforce development are needed to install, operate, and maintain the Suggested Solution.
    iii. Provide a listing and description of the various job titles/classifications and qualifications for the installation, operation, and maintenance of the Suggested Solution.
    iv. What engineering and specialist skill sets are recommended to effectively maintain and operate your Suggested Solution.
34. Provide a statement of understanding that LADWP would be able to contact your firm for additional information to further investigate the response to the RFI at no cost to LADWP.

## B. HYDROGEN PRODUCTION

Please provide answers and/or information to satisfy the following questions related to hydrogen production technologies that may be used in supporting the future electricity generation needs of the City of Los Angeles. These hydrogen production technologies include, but are not limited to, electrolysis, green ammonia production, ammonia cracking, pyrolysis, and steam methane reforming (SMR) with carbon capture. LADWP may consider the temporary use of hydrogen produced via established methods for the purposes of pilot project(s) or for demonstration(s) provided that there is a pathway to the utilization of green hydrogen.

The requested information for hydrogen production is as follows:

1. Provide information on the processes used to produce hydrogen for your Suggested Solution.
2. Provide information on the needed feedstocks of your Suggested Solution.
3. What amount of hydrogen, measured in metric tonnes, is provided by your Suggested Solution?
4. What level of hydrogen purity is the Suggested Solution able to provide? Are there any non-hydrogen chemical constituents that are expected to be delivered along with the hydrogen?
5. Provide information on the balance of plant requirements for the scale and scope of your Suggested Solution.
6. Would your Suggested Solution experience losses? If so, provide information on the rate of expected losses and methods for mitigation.
7. If applicable, what are the expected GHG emissions of your Suggested Solution?
8. If applicable, what measures and/or technologies does your Suggested Solution utilize to eliminate or minimize GHG emissions?

9. Describe a cursory end-to-end lifecycle environmental impact analysis of the Suggested Solution.
10. Provide information about your Suggested Solution's ability to respond to fluctuations in power often associated with power sourced from variable energy resources.
11. If your Suggested Solution requires process heating or cooling, what source of energy (resistive heating, heat storage, waste steam heat, hydrogen combustion, etc.) is recommended?
12. If your Suggested Solution will utilize carbon capture and sequestration (CCS), please describe the type of carbon capture technology recommended and the end use of the captured carbon.
13. Provide information on the software used by your firm to model hydrogen production.
14. The following information requested pertains specifically to ammonia cracking technologies:
    i. Provide information on your firm's suggested ammonia cracking technology.
    ii. Provide information on balance of plant requirements for your firm's ammonia cracking technology.
    iii. Provide information on the heat source and GHG emissions associated with the ammonia cracking process.
    iv. Provide information on the expected ammonia slip rate and any available mitigation measures in your Suggested Solution.
    v. Provide information on the expected efficiency of your Suggested Solution's ammonia cracking technology.

## C. HYDROGEN TRANSPORTATION

Please provide answers and/or information to satisfy the following questions related to hydrogen transportation technologies and methods that may be used in supporting the future electricity generation needs of the City of Los Angeles. These hydrogen transportation technologies and methods include, but are not limited to, pipelines, railways, trucks, ships, and barges.

The requested information for hydrogen transportation is as follows:

1. Provide information on the method of transportation used in your Suggested Solution.
2. Hydrogen is currently transported using numerous forms to increase hydrogen density, which include but are not limited to, compressed gas, green ammonia, liquified hydrogen, or other hydrides. Please specify which form(s) of hydrogen would be transported in your Suggested Solution.
3. What experience does your firm have in the transportation of hydrogen, ammonia, gas products, and/or fuels?
4. What measures would be taken to eliminate, minimize, or mitigate GHG emissions in your Suggested Solution?
5. What quantities of hydrogen are expected to be delivered by your Suggest Solution?

6. How many deliveries per day, week, and/or month would be expected in providing LADWP with the projected hydrogen or ammonia quantities through your Suggested Solution?
7. What safety measures and precautions would be taken to minimize safety risks associated with transportation?
8. What limitations, if any, are inherent in your Suggested Solution?
9. What assumptions have been made in relation to travel route, length of trip, and means of travel?
10. If using maritime means, what is the assumed port of origin and assumed port of destination for your Suggested Solution?
11. If using pipelines, specify the existing pipeline network to be used or the proposed routing of future pipelines to be constructed or repurposed.
12. Does your Suggested Solution experience losses during transportation? Will on-route delays result in losses? How will these losses be mitigated and/or addressed?

## D. HYDROGEN STORAGE

Please provide answers and/or information to satisfy the following questions related to hydrogen storage technologies and methods that may be used in supporting the future electricity generation needs of the City of Los Angeles. These hydrogen storage technologies and methods include, but are not limited to, hydrogen stored as ammonia, compressed gas hydrogen storage, liquid phase hydrogen storage, and hydrogen stored as hydrides. Hydrogen storage infrastructure may include, but are not limited to, above-ground tanks, underground tanks, geologic storage, line packing, refrigerated storage, and maritime barge storage.

The requested information for hydrogen storage is as follows:

1. Provide information on the method of storage for your Suggested Solution.
2. Provide information on the technologies and/or methods used in your Suggested Solution.
3. What hydrogen storage infrastructure would be required in your Suggested Solution?
4. Where would your Suggested Solution be located? Would it be co-located at one of LADWP's existing facilities? If so, which LADWP facility?
5. What are the operating temperatures and pressures for your Suggested Solution?
6. What are the energy requirements for your Suggested Solution?
7. Would your Suggested Solution require utility services? If so, what would be required?
8. Would your Suggested Solution experience hydrogen losses over time? If so, provide information on the rate of expected losses and methods for mitigation.
9. Describe any experience your firm has with similar applications using the techniques and technologies in your Suggested Solution.
10. Provide information on the software used by your firm to model hydrogen storage.
11. What permitting and safety measures and precautions would be taken to minimize safety risks associated with the storage of hydrogen fuel?

12. Provide information on the periodic testing required for the safe operation of your Suggesting Solution.
13. Provide information on the scalability of your Suggested Solution.

## E. ELECTRICITY GENERATION

Please provide answers and/or information to satisfy the following questions related to hydrogen-based electricity generation technologies and methods that may be used in supporting the future generation needs of the City of Los Angeles. These hydrogen-based electricity generation technologies include, but are not limited to, hydrogen retrofits of existing natural-gas-based combustion turbines, hydrogen-fueled combustion turbines in both simple cycle and combined cycle configurations, fuel cells, and ammonia/hydrogen co-fuel combustors.

The requested information for hydrogen-based electricity generation is as follows:

1. Provide information on the technologies and methods of electricity generation in your Suggested Solution.
2. What are the operational characteristics, as applicable, of your Suggested Solution? Information may include, but is not limited to:
    i. maximum net output
    ii. minimum net output
    iii. ramp rates
    iv. heat rates
    v. efficiencies
    vi. emissions
    vii. ancillary services
3. If your Suggested Solution includes the retrofit of CT combustors, provide a list of compatible CT models. Will your Suggested Solution be compatible with existing CTs in LADWP's generation fleet?
4. What are the external dimensions of retrofit combustors? What considerations must be taken for installation clearance in regards to the existing CTs and surrounding structures?
5. What is the maximum and minimum amount of hydrogen, in volume percent, that can be utilized in your Suggested Solution? If the maximum is not 100%, does your Suggested Solution have a development plan to achieve 100% hydrogen combustion?
6. Does your Suggested Solution require a co-fuel or dilutant? If so, which co-fuels or dilutants are required?
7. For Suggested Solutions pertaining to CTs, what is the expected heat rate for the hydrogen-capable CT? How has this heat rate been determined?
8. For Suggested Solution pertaining to CTs, what are the expected NOx emissions, given in parts per million (ppm), at the CT exhaust? What are the major permitting requirements associated with hydrogen-based electricity generation?
9. Does your Suggested Solution require water or steam injection for NOx control? If so, what injection rates are required?

10. Provide information on any needed changes to existing infrastructure to include, but not limited to, fuel system sizing, fuel system materials, fuel compressors, fuel blending equipment, water/steam injection infrastructure, and NOx abatement.
11. What are the cooling requirements for your Suggested Solution? What cooling methods are recommended?
12. Provide information on established guidelines and/or procedures for conducting testing and commissioning.
13. Provide information on black start capabilities of the Suggested Solution.
14. The following information requested pertains to fuel cell technologies:
    i. Provide information as to the availability and annual production rate of fuel cells for your Suggested Solution.
    ii. Provide information about the chemistry in your Suggested Solution's fuel cells.
    iii. Provide information on the operational characteristics for your Suggested Solution's fuel cells, including rated net power, DC voltage range, and current.
    iv. Provide information on the reversibility of your Suggested Solution's fuel cells, including the time required to switch between electricity-generating mode and hydrogen-production mode.
    v. What is the expected operational life span of the fuel cells? What factors and/or best practices can improve operational life span?
    vi. Provide information on how safety by design will be implemented.
    vii. Provide information on the required subsystems and how they will be integrated (e.g., air subsystems, cooling subsystems).
    viii. Provide information on required fuel supply and flow rate? What are the fuel composition requirements?
    ix. Provide information on the scalability of your Suggested Solution.
    x. Provide information on the cooling requirements to include required coolant volume and chemical composition.

## F. SAFETY AND ENVIRONMENTAL STEWARDSHIP

The safety of the people of Los Angeles, LADWP employees, and all communities surrounding the LADWP generating facilities are of paramount importance to LADWP. With the understanding that other industry sectors have over 100 years of experience with the industrial use of ammonia and hydrogen, LADWP requests information regarding technologies, best practices, and lessons learned in the areas of hydrogen and ammonia safety. These hydrogen-centered safety technologies and topics include, but are not limited to, gas detection, flame detection, personal protective equipment (PPE), best practices, and lessons learned. Given LADWP's core commitment toward environmental stewardship, LADWP also seeks information on technologies and methods to continue this commitment as it moves toward novel, hydrogen-based methods of electricity generation. Collectively speaking, these technologies may be used to safely and responsibly operate hydrogen-related infrastructure to support the future electrical generation needs of the City of Los Angeles.

The requested information regarding safety and environmental stewardship is as follows:

1. Provide information about hydrogen and/or ammonia gas detection technology.
2. Provide information on hydrogen and/or ammonia leak detection technology.
3. Provide information on hydrogen fire and flame detection technology.
4. Provide information on methods and materials used to contain ammonia spillage and emergency response.
5. Provide information on PPE related to hydrogen and/or ammonia.
6. Provide information on fire detection and fire suppression systems.
7. Provide information on your firm's best practices and lessons learned as relates to personnel, equipment, safety by design, and environmental safety.
8. Provide information on catalyst technologies or other DeNO$_x$ technologies. Generally speaking, LADWP's permits allow for 2.5 ppm NO$_x$ for its simple cycle units and 2.0 ppm NO$_x$ for its combined cycle units.[6]
9. Provide information on the safety codes and standards for hydrogen and ammonia.
10. Provide information on continuous monitoring applications and shutdown procedures.
11. Describe how the Suggested Solution would assist LADWP in meeting its objectives to provide benefits to its residents located in disadvantaged communities and with low-to-moderate incomes through direct employment and economic development?

## 4. CONCLUSION

Ultimately, LADWP believes this RFI is a step toward achieving its clean-energy goals and maintaining a reliable and resilient power system, all while providing cost-competitive rates to its customers. LADWP remains committed to helping accelerate the advent of a decarbonized, clean-energy future and looks forward to reviewing responses to this RFI.

[6] Stated limits are without consideration of LADWP's participation in the South Coast Air Quality Management District's (SCAQMD) Regional Clean Air Incentives Market (RECLAIM) Program.

## 5. INFORMATION AND INSTRUCTIONS

### SCHEDULE OF EVENTS AND CONTACT INFORMATION

| | |
|---|---|
| Release of RFI | **August 5, 2021** |
| Respondents' Questions Due | **August 26, 2021** |
| LADWP Response to Written Questions | **September 2, 2021** |
| Deadline for Submitting RFI Responses | **October 7, 2021** |

All questions or concerns related to this RFI should be submitted via electronic mail to Shaun Larsuel, Utility Buyer, at SCS3Purchasing@ladwp.com by the date and time prescribed herein. The LADWP's responses to questions will be posted on the Los Angeles Business Assistance Virtual Network (LABAVN), found at https://labavn.org. It is the responsibility of respondents to check LABAVN periodically for responses to questions.

### USE OF INFORMATION

Participation in this RFI is optional and not required in order to respond to any subsequent procurement LADWP may take. The RFI is not a competitive solicitation method. Except as otherwise set forth herein, neither LADWP nor the interested party responding has any obligation under the RFI. LADWP anticipates to issue an RFP/RFPs using information gathered from responses to this RFI. Interested parties are encouraged to submit responses to all or part of the RFI even if they do not have a current intention to respond to any future requests. Respondents are specifically requested not to submit any type of price proposal other than high-level cost estimates for budget purposes.

All documents submitted in response to the RFI will become a matter of public record and shall be thereupon considered public records. If a respondent believes that any portion of its response is exempt from public disclosure, such portion shall be clearly marked "Trade Secret," "Confidential," or "Proprietary." By submitting information with portions marked in this manner, the respondent represents that it has a good faith belief that such material is exempt from disclosure under the California Public Records Act, California Government Code §§ 6250, et. seq.

### GENERAL INFORMATION AND INSTRUCTIONS

Companies responding to this RFI shall designate a single contact within that company for receipt of all subsequent information regarding this RFI. If subsequent bidding opportunities are issued, LADWP is under no obligation to advise any vendor responding to this RFI.

LADWP employs the City of Los Angeles – Business Assistance Virtual Network (LABAVN) website for posting its bidding opportunities. Vendors are advised to monitor the LABAVN website for such opportunities. Entities or individuals interested in such opportunities need to register on the LABAVN website. Registration is free and enables the registered entity or individual to gain access to certain information, services and/or materials maintained on LABAVN at no charge. Registration may be accomplished at: https://labavn.org.

## CONTACT INFORMATION

Please provide your contact information including a brief company profile, and the name, phone number, and email of the key contact person(s).

## RFI SUBMITTAL INSTRUCTIONS

RFI responses will only be accepted electronically via the Ivalua web portal found at https://suppliers-ladwp.ivalua.app/. Vendors already registered on LADWP's Ivalua submittal portal can log into their account and navigate directly to the solicitation using the RFI number. Vendors that are not currently registered will need to complete the free registration. Registration instructions and a Vendor User Guide that includes instruction on how to submit an electronic response can be found on the Ivalua website. Responses submitted via electronic mail (email), facsimile, or hardcopy will not be accepted.

## APPENDIX A: LADWP ELECTRICITY-GENERATING UNITS

### Table A. LADWP In-Basin Generation Fleet

| GENERATING STATION<br>Address | UNIT NO. | MANUFACTURER | UNIT MODEL<br>CT: Combustion Turbine<br>ST: Steam Turbine<br>†: Combined Cycle | NET MAXIMUM UNIT CAPACITY (MW) | NET MAXIMUM PLANT CAPACITY (MW) |
|---|---|---|---|---|---|
| **Harbor Generating Station**<br>161 N. Island Ave.<br>Wilmington, CA 90744 | 1 | General Electric | 7EA / CT† | 73.0 | 443.0 |
| | 2 | General Electric | 7EA / CT† | 73.0 | |
| | 5 | Westinghouse | ST† | 60.0 | |
| | 10 | General Electric | LM6000 / CT | 47.4 | |
| | 11 | General Electric | LM6000 / CT | 47.4 | |
| | 12 | General Electric | LM6000 / CT | 47.4 | |
| | 13 | General Electric | LM6000 / CT | 47.4 | |
| | 14 | General Electric | LM6000 / CT | 47.4 | |
| **Haynes Generating Station**<br>6801 E. 2nd St.<br>Long Beach, CA 90803 | 1 | Brown Boveri | ST | 222.0 | 1,614.2 |
| | 2 | Brown Boveri | ST | 222.0 | |
| | 8 | General Electric | D11 / ST† | 250.0 | |
| | 9 | General Electric | 7FA / CT† | 162.5 | |
| | 10 | General Electric | 7FA / CT† | 162.5 | |
| | 11 | General Electric | LMS100 / CT | 99.2 | |
| | 12 | General Electric | LMS100 / CT | 99.2 | |
| | 13 | General Electric | LMS100 / CT | 99.2 | |
| | 14 | General Electric | LMS100 / CT | 99.2 | |
| | 15 | General Electric | LMS100 / CT | 99.2 | |
| | 16 | General Electric | LMS100 / CT | 99.2 | |
| **Scattergood Generating Station**<br>12700 Vista Del Mar<br>Playa del Rey, CA 90293 | 1 | General Electric | F2 / ST | 105.0 | 778.2 |
| | 2 | General Electric | F2 / ST | 156.2 | |
| | 4 | General Electric | 7FA / CT† | 206.0 | |
| | 5 | General Electric | A-14 / ST† | 107.0 | |
| | 6 | General Electric | LMS100 / CT | 102.0 | |
| | 7 | General Electric | LMS100 / CT | 102.0 | |
| **Valley Generating Station**<br>11801 Sheldon St.<br>Sun Valley, CA 91352 | 5 | General Electric | LM6000 / CT | 43.0 | 576.0 |
| | 6 | General Electric | 7FA / CT† | 162.0 | |
| | 7 | General Electric | 7FA / CT† | 162.0 | |
| | 8 | General Electric | D11 / ST† | 209.0 | |