I. Overview of the Obsidian Pacific Northwest Hydrogen Hub. The Obsidian Pacific NW Hydrogen Hub (the "Hub") is a joint venture to establish integrated renewable energy and clean and green hydrogen infrastructure. It will include electrolytic hydrogen production, from new, purpose-built wind and solar, long duration modular storage and low cost, last-mile distribution to industrial, commercial, and agricultural users across Oregon and Washington. The Hub's hallmark features are its modularity, reliance on new renewable energy to produce electrolytic hydrogen, and comprehensiveness in operation and production. Modularity allows the large-scale project to economically expand in new sections as demand for hydrogen grows. Comprehensiveness alludes to the additional renewable energy for generation, the multiplicity of use sectors, the geographic reach, and the complete plan for production, storage, transportation, and consumption. We project that the Hub will begin producing hydrogen by 2026 and be completed to its design by 2032, with continued expansion thereafter. We seek $700 million of DOE H2 Hub funding to support this project.

The Pacific Northwest has abundant hydropower resources. While the base (or "firm") hydro generation is fully subscribed in wholesale transactions, there are very substantial surplus purchase opportunities depending on the amount of water in the river, and the surplus varies widely by season and by year. By drawing on wind, solar, and firming with hydro, the Hub ensures this electrolyzer infrastructure will be utilized at the lowest cost (direct connect solar and wind supplemented by targeted market purchases of hydro will cost less than any regional utility tariff.)

The Hub will provide reliable, cost-efficient hydrogen gas storage and delivery capabilities and displace coal-generated electricity, diesel power generation and natural gas feedstock, including in sectors that are difficult to decarbonize. It will improve the resilience of the overall electricity system. Construction and management of the Hub and the projects it enables will create more than 4,000 construction jobs and 500 permanent jobs, largely in disadvantaged census tracts across Northeastern Oregon and Central and Eastern Washington.[1] The Hub intends to directly benefit Native American populations and disadvantaged communities in the area by diversifying economic and career opportunities (including apprenticeships), strengthening access to secure electricity and fuels, contributing to Tribal energy sovereignty and community self-determination through ownership and management agreements, all tailored to local priorities and resources. Importantly, the completion of hydrogen infrastructure will also provide a valuable clean energy and fuel resource to users of diesel fuel, including backup emergency power generators, transportation, commercial farmers, and other agricultural sector participants in the Pacific Northwest. Hydrogen produced by electrolysis for the Hub should have long range price stability due to long term power purchase agreements with wind and solar farms, allowing reduced exposure to supply interruptions and market volatility.

The Hub's hydrogen will be used for industrial manufacturing feedstock, including production of ammonia for domestic fertilizer, power generation at regional utilities and as backup power to

[1] Estimate is based on direct jobs associated with the pipeline, storage, electrolyzer, and new renewable energy projects based on internally compiled figures from a variety of sources.

the concentration of data centers in the region (to replace diesel gensets). The economies of scale from this level of production, combined with low-cost delivery via pipeline, will attract transportation applications that will increase over time. These include material handling, drayage, distribution warehouse fleets, highway fueling stations, transit agencies and even rail and aircraft applications. These are expected to be achievable longer-term growth opportunities once hydrogen production, transport, and storage come online. In addition, the Hub will provide a national model for reducing reliance on natural gas. Oregon and Washington lawmakers have banned coal from the electricity mix and greatly restricted natural gas for the next 13 years. Oregon requires utilities to reduce emissions by 80 percent from a baseline amount by 2030, 90 percent by 2035, and 100 percent by 2040. Washington requires utilities to be greenhouse gas neutral by 2030. These decisions accelerate the need for hydrogen alternatives and guarantee a growing market. Our Hub will be a national leader in the development of new hydrogen combustion turbines to replace existing natural gas, for replication around the country.

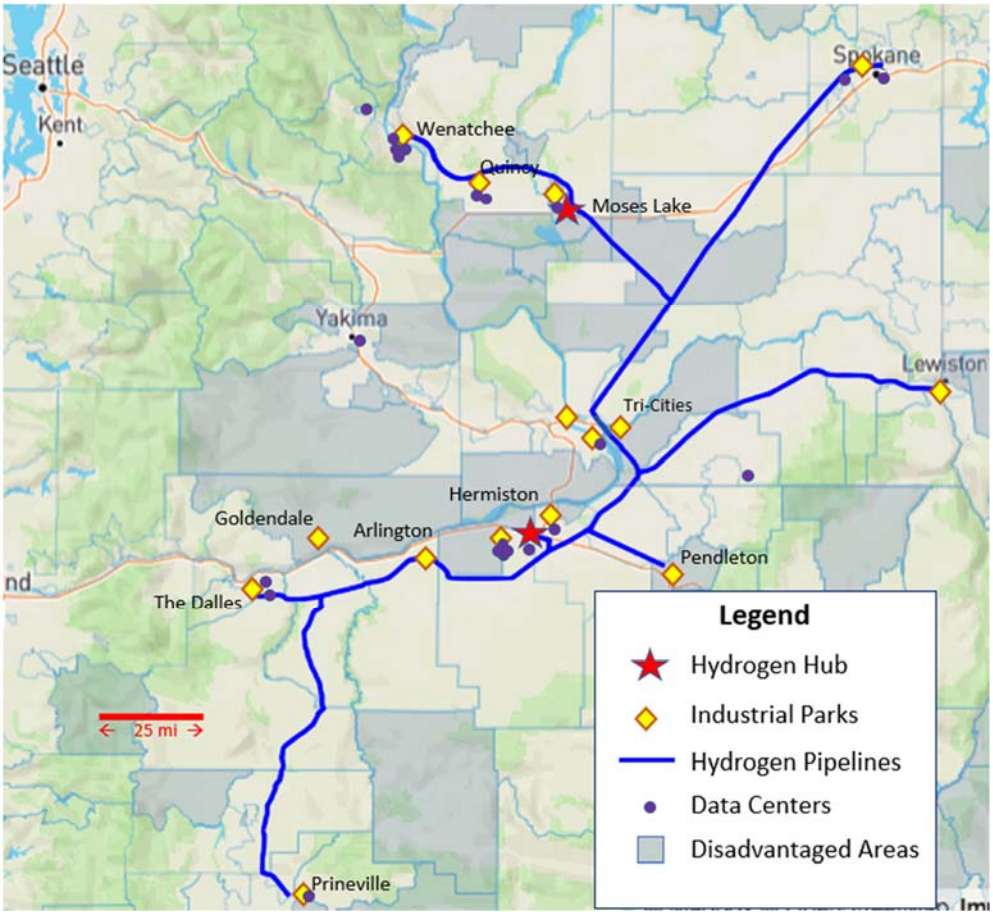
II. Hub Details. As shown in Figure 1 below, the Hub consists of a new, dedicated hydrogen pipeline of approximately 590 miles anchored by two electrolytic hydrogen facilities, each capable of producing approximately 175 metric tons (MT) daily at each anchor (Hermiston and Moses Lake) with 2,500 MT of underground manifold storage. Together, the manifold storage and main pipeline will be capable of storing 6,000 MT of hydrogen. In addition to storage, the main pipeline serves as a network for regional hydrogen distribution. Multiple modular facilities (solar and wind resources, paired with electrolyzers and underground storage, tapping into the pipeline) will be developed along the pipeline route. The current Hub proposal anticipates production of an additional 175 MT (aggregate) from modular facilities potentially located in Quincy and Wenatchee, Washington, and Arlington, The Dalles, and Prineville, Oregon, bringing our daily maximum hydrogen yield for this project to 525 MT per day. Inherent in the Hub design is the ability to increase production by adding modular facilities as and when demand increases, and to expand the pipeline to meet future opportunities.

A. Anchor Sites. Each of the two anchor sites will be constructed in proximity to 400 MW of new solar as the primary source of renewable energy for electrolysis. Secondary energy sources will be available to each site from nearby wind farms and through market power purchases of renewable electricity from local electric utility providers (Umatilla Electric Cooperative (Oregon)) and Grant County Public Utility District (Washington)), which produce clean base load electricity from hydropower dams in the region.[2] These renewable energy sources will connect to a 400 MW electrolyzer at each Hub site capable of producing 175 MT of hydrogen per day. Each anchor

[2] The Umatilla Electric Cooperative, a member of the Project's Steering Committee, serves a large portion of the Columbia Basin in Northeastern Oregon. Its service territory includes many of the region's data centers, which comprise a vast majority of UEC's current load. (UEC 2021 Annual Report.) Grant PUD is a public utility providing power and fiber service for Grant County, WA. It owns and operates the Priest Rapids Project on the Columbia River in Central Washington. The Priest Rapids Project, comprising Priest Rapids and Wanapum dams, has the capacity to produce more than 2,000 megawatts of clean, renewable, and reliable electricity. Grant PUD generates more than 2,100 megawatts of clean, renewable, reliable energy at some of the most affordable rates in the country. https://www.grantpud.org/about-us.

site will be paired with 2,500 MT of underground storage manifolds, providing a safety stock of hydrogen inventory to meet fluctuating end user demands and a superior, low-cost form of long duration storage.

Figure 1: Obsidian Pacific Northwest Hydrogen Hub and Disadvantaged Communities.[3]



i. Details of Oregon Anchor Site (Hermiston). The Columbia Development Authority[4] (CDA) is developing a new industrial park on the decommissioned U.S. Army Umatilla Chemical Weapons Depot. In connection with the redevelopment plan, the CDA will receive approximately 5,500 acres and the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) will receive approximately 4,000 acres. The Hub includes development on both CDA and CTUIR land at the Depot. Obsidian delivered a letter of intent to develop at the Depot to the CDA in April 2022, and in August 2022 delivered a Term Sheet for an Option Agreement. The CDA is currently reviewing the option terms for both solar and hydrogen development leases at the Depot and we expect the Hub to be a foundational tenant supporting further implementation of the CDA's economic

[3] Map sourced from https://www.whitehouse.gov/environmentaljustice/justice40/; shaded areas indicate census tracts identified as disadvantaged. Data center locations from https://baxtel.com/data-center/pacific-northwest.
[4] The Columbia Development Authority is an intergovernmental body formed by agreement between the Port of Morrow, the Port of Umatilla, Morrow County, Umatilla County, and the CTUIR.

development plan for the Depot. As a tenant on the site, the Hub will contribute immediate income and economic development to the CDA through property taxes and rent while providing both renewable energy and renewable hydrogen to attract and support tenants. The CTUIR is investigating co-development with Obsidian of its Depot land to create revenue to support wildlife restoration and preservation activities on other portions of the CTUIR land. The Depot has more than 2,000 acres zoned for solar development under the applicable economic redevelopment plan, easy access to two interstate highways and the Columbia River, and existing roads, rail, water, and electricity services, which the CDA is expanding to accommodate future tenants. The location is surrounded by ample wind resources, is near the crossroads of two interstate natural gas pipelines and has more than 2 GW of natural gas electric power generators within 20 miles.[5] The Hub provides the opportunity to displace natural gas with hydrogen-driven power generation. All five gas turbine owners in the area have expressed to us in hydrogen at the Hub to reduce the carbon intensity of their power supplies to help meet state carbon emission reduction targets.

ii. Details of Washington Anchor Site (Moses Lake). The Port of Moses Lake was selected as an anchor site because it includes an airport and industrial areas with more than 5,700 acres of quality infrastructure and the Port has its own hydrogen development plan to support a wide range of industrial, aviation and commercial businesses. Obsidian is working to establish three initial potential off-takers at the Hub: a 40-120 MW hydrogen-capable power plant for Grant PUD, a 100 MW electrolyzer and liquefaction facility for Plug Power, and a 500-1,000 ton per day ammonia production facility. The Grant PUD has project, for example would result in 40-120 MW of high reliability non-fossil flexible dispatchable generation to meet its growing loads. This project could add up to 50 MT per day production capacity and 200 MT of additional local storage. Obsidian has hired Carbon Neutral Consulting to help identify an ammonia manufacturer for this site. Meetings with three interested ammonia manufacturers are in process (Nutrien, Simplot, and Incitec Pivot). The Port has executed a letter of intent to negotiate multiple development sites at the Port to support the Hub and position the Port as a Hub anchor site and a supplier of green hydrogen to new and existing tenants.

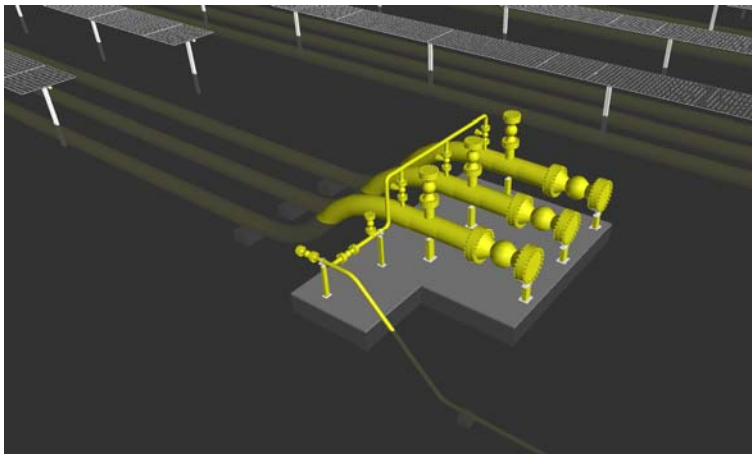
B. Storage, Collection and Distribution Pipeline. The proposed Hub includes a new, dedicated pipeline serving three primary functions: storage, collection, and distribution. The pipeline is integral to the storage and distribution of hydrogen to end users across Oregon and Washington.

i. Storage: Manifold and Main Pipeline. Preliminary engineering for the manifold storage assembly has been completed by Coffman Engineers (Figure 2). The conceptual layout for the design accommodated 240 MT of hydrogen storage per 150 acres located underground between solar panel rows. We have examined both metallic and non-metallic pipes. Further research and engineering are required to optimize materials, pressure, and layout. The preliminary design shows three (3) 12” diameter non-metallic lines running between each row of solar panels,

[5] Per Northwest Power and Conservation Council data, see: https://nwcouncil.org/energy/energy-topics/power-supply/map-of-power-generation-in-the-northwest/

storing 240 tons of hydrogen gas at 70°F and 2,000 psig (~140 bar). This design allowed for both segmentation of the storage (i.e., using various fractions of the total capacity) and inspection ports. This conceptual layout includes 200 miles of 12" diameter pipe for storage and considers ASME B31.8 for pipe separation distance (57 inches).

Figure 2: Illustration of the three (3) 12" storage manifold lines under rows in PV solar facility.



The Hub includes a new, dedicated, hydrogen-only storage pipeline. Preliminary engineering and site determination for the main pipeline will be completed in Phase 1 of the DOE funding period, but a preliminary conceptual design has been developed. It contemplates a twinned 8"-10" diameter non-metallic pipeline. The pipeline will connect the two anchor sites with a 110-mile segment that passes through the Tri Cities and Walla Walla regions. Additional segments will run north to users in Wenatchee, Quincy, and Spokane, west to Arlington and The Dalles, south to Prineville and east to Pendleton. In full, the main pipeline spans approximately 590 miles. These routes will reach most of the region's 600+ MW of data center load, more than 2 GW of natural gas turbines, distribution warehouses, ports, transit agencies and other users establishing a truly regional infrastructure. The main pipeline combined with the manifold storage offers a total storage capacity of approximately 6,000 MT of hydrogen.[6]

ii. Collection and Distribution. In addition to the 350 MT per day hydrogen production capacity at the anchor sites, additional renewable energy, and electrolysis facilities (solar, wind, or a combination) will be developed at points along the main pipeline route to inject additional hydrogen into the main pipeline as demand grows. An ideal modular expansion site, for example, is an industrial site that is zoned for or can be conditionally approved for electrolyzer use, with an adequate water supply and a good connection to the electric grid. Well-suited sites have bene examined at Spokane, Tri-Cities, Quincy, Wenatchee, Arlington, Boardman, and Prineville. These modular facilities can be scaled to fit available sites and demand. The main pipeline provides a distribution network to deliver hydrogen to end-users across Central and Eastern Oregon and Washington. Multiple spur lines from the main storage pipeline will deliver hydrogen across the region. Importantly, direct pipeline connection (the strategy deployed by our natural gas system) provides a reliable, low-cost means of delivery compared to hydrogen liquefaction and transport by truck.

[6] The Inflation Reduction Act contains a 30% investment tax credit for hydrogen storage (which can be increased to 50%). Recent increases in commodity prices make the tax credit especially important to the sizing of the storage for this project. Future fluctuations in commodity prices may affect the optimal sizing of the storage.

III. Customers. The Hub will serve data centers, food processors, distribution centers, advanced information technology and communication companies, and domestic semi-conductor suppliers and manufacturers, among others. The Hub will directly benefit the agricultural sector by replacing natural gas used in the production of imported ammonia fertilizer with 100% renewable hydrogen and by replacing diesel engine applications across commercial farming with clean hydrogen. Core customers served by our Hub can be segmented into three categories: (A) Anchor Tenant customers with high volume, frequent demand for hydrogen; (B) customers with high-volume but infrequent demand for hydrogen – such as Emergency Backup Generators, and (C) Last Mile Customers with low volume demand or a use-case that is not yet economic without subsidy, including hydrogen vehicle fueling stations, ports, and transit agencies.

A. Anchor Tenants. In the first category of Hub customers are the anchor tenants; customers expected to require dozens of metric tons of hydrogen per day on average on a regular basis. There are two general types of customers in the Anchor Tenant category: industrial customers, and dispatchable firming generation customers. Industrial customers require high volumes of low-cost, reliable hydrogen, but may be able to curtail use if required in emergency conditions.[7] This category includes material and equipment manufacturers (e.g., REC Silicon at the Port of Moses Lake Industrial Park), warehouse operations fuel providers (e.g., Plug Power and Linde), regional green fertilizer production facilities, and others. The second type of anchor tenant customer, dispatchable firming generation customers. They require large volumes of hydrogen on a regular basis, but not on a continuous basis. Dispatchable firming generation users place high value on the capacity benefits of reliable high-volume and long-durational storage.[8] These customers value the flexibility of hydrogen to be dispatched reliably for different periods of duration based on electricity demand. This category includes as examples, Perennial Power, Portland General Electric, Grant PUD, and Puget Sound Energy, all of whom are participating in our Hydrogen Combustor Working Group (see Section IV.A. below).

B. Emergency Backup Generation Users. The second category of Hub customers rely on highly dependable, backup electricity generation to sustain uninterrupted operations during periods of grid disruption. Pacific Northwest generators mostly use fossil fuel, typically diesel. With an expansive storage and distribution pipeline network, the Hub will support reliable, on-demand backup power for use in emergency conditions and will eliminate diesel emissions across multiple sectors. Included in this customer category are data centers along the Hub but we do not yet have firm commitments.[9] Also, hospitals, water treatment facilities, emergency response centers, operators of commercial real estate, food processing facilities and retail grocery stores employ backup diesel generators and will have hydrogen service available from the Hub.

C. Last Mile Package Customers. The third category of customers are smaller-scale users with modest energy demands. When aggregated, these end users can form a meaningful market,

[7] For example, ammonia manufacturers can cut back production, relying on ammonia they have in storage to cover supply interruptions.

[8] For example, emergency backup generation for data centers, hospitals, and other critical infrastructure to cover power grid outages.

[9] Data centers along the Hub include those operated by Amazon, Apple, Google, Meta, and Microsoft.

may have the greatest carbon emission reductions per kilogram of hydrogen used, and represent ongoing growth for the hydrogen hub. As illustrated in Figure 3 below, the Last Mile Package is the infrastructure needed to reach those markets from the main pipeline. Last Mile customers include local government entities such as Indian Tribes, port authorities, and water treatment plants, rural industrial parks, transportation users including distribution warehouses, airports, transit districts, school bus fleets, rail yards, and maritime terminals, and public fueling stations. Many of these customers are operating in carbon intensive industrial sectors that are difficult to decarbonize. Transportation is especially important, representing the single largest carbon emission sector in the Northwest. Upon completion, the Hub will be the most affordable and reliable hydrogen delivery option available to last-mile customers and small businesses.

Figure 3: Last Mile Package Infrastructure

Hydrogen on the Farm (trademark pending) is a Last Mile initiative for engaging farmers in hydrogen production and use. The prospect of providing farmers with the means to make their own fuels and microgrids to increase resilience and decrease dependence on market energy price volatility is enticing. Large tractors and other large farm equipment are less amendable to battery electrification. Farmers wanting to develop otherwise suitable solar sites are hamstrung due to lack of transmission capacity to move the power, and hydrogen provides an opportunity for farmers to make economic use of otherwise untapped potential.

Apart from the Hydrogen on the Farm initiative, we have identified the following potential Last Mile Package customers near the pipeline:

Table 1: Last Mile Package customers

Potential Customer	Hydrogen Opportunity
Distribution Centers (e.g., Amazon, Costco, Federal Express, Walmart)	Transportation, warehouse operations (e.g., hydrogen forklifts), backup power
Airports (e.g., Moses Lake, Pendleton, Spokane, Tri-Cities)	ground handling equipment, aviation, transportation, backup power, drone program (Pendleton)
Industrial Parks (e.g., City of Arlington (Mesa), Moses Lake, Spokane, Tri-Cities, Quincy)	Drone program Rockets/Aviation, REC Silicone, Universal Hydrogen
Other (e.g., Darigold/Tri-Cities, Lamb Weston, Simplot, Fairchild Air Force Base (Spokane), CTUIR)	Shipping/Transportation; Fertilizer/Ammonia Farming equipment; irrigation pump power, backup power; ground handling equipment, aviation, transportation, backup power, hydrogen fueling station

IV. Development Plan. In January 2022, Obsidian formed an advisory Steering Committee, which has since met monthly, to gather knowledge and experience from sector experts, solicit input on project shaping to reflect local community and Tribal priorities, support innovation in hydrogen applications in our region, advance planning and design and troubleshoot engineering challenges. Among the Steering Committee's over thirty members are industry leaders Sumitomo, through its affiliate Perennial Power,[10]Siemens Energy,[11] Plug Power,[12] Vestas North America,[13] and SOLV Energy[14]. Additionally, we have led community outreach to support and educate key stakeholders on forthcoming policies and benefits of hydrogen adoption, as well as to invite collaborative input on desired community benefits from landowners and farmers, labor unions, tribal leadership, county commissioners and small business owners across the region.

[10] **Perennial Power, Inc.** was formed by Sumitomo to invest in independent power plants in North America. It owns, operates, and manages power plants, focusing on conventional and geothermal power generating technologies, as well as on enhancement of reliable power grids, including energy storage. http://www.perennialpower.net

[11] **Siemens Energy** is one of the world's leading energy technology companies. The company works with its customers and partners on energy systems for the future. Siemens Energy covers the entire energy value chain – from power generation and transmission to storage. https://press.siemens-energy.com.

[12] **Plug Power** has deployed more than 50,000 fuel cell systems and over 165 fueling stations and is the largest buyer of liquid hydrogen. Plug will deliver its green hydrogen solutions directly to its customers and through joint venture partners into multiple environments, including material handling, e-mobility, power generation, and industrial applications. https://www.ir.plugpower.com

[13] **Vestas** is a market leader in the North American wind industry with 42,000 MW installed and 38,000+ MW under service in the U.S. and Canada. Vestas employs more than 6,000 people in the manufacturing, installation, and service of onshore and offshore wind turbines.

[14] **SOLV Energy**, formerly a division of Swinerton Builders, is one of the largest solar EPC contractors in the United States, having built over 9 GW of solar energy projects. https://www.solvenergy.com/about-us.

Finally, we have advanced partnerships with development and capital partners necessary to support long-term investment and construction of hydrogen infrastructure. Obsidian has and will continue to coordinate with the Pacific Northwest Hydrogen Association ("PNHA").[15] Obsidian's Director of Hydrogen Development, Ken Dragoon, sits on the PNHA Advisory Committee and Renewable Hydrogen Alliance Board of Directors. Many of our partners, supporters, and steering committee members also participate in PNHA.

A. Key Risks and Challenges. The United States has 1,600 miles of dedicated hydrogen pipeline today, but development and engineering investments are called for to optimize materials and systems for new hydrogen-dedicated pipelines. This includes front end engineering and design and a materials analysis for the main pipeline and hydrogen storage fields. We will work with our engineers and the Center for Hydrogen Safety to understand the design challenges, including safety. In addition, the regulatory frameworks need to be thoroughly understood, including siting and permitting jurisdiction, safety, and operational oversight. An advantage of the Hub is that the main activities in and around Moses Lake involve only one county, and the activities in and around the Depot involve only two counties. The one area where Technology Readiness Levels (TRL) are below 9 is hydrogen-fueled power plants. There are three main technologies, each of which Obsidian's engineering team estimates to be TRL 6 and expects to be available at scale in the next two or three years: 1) stationary fuel cell systems; 2) hydrogen reciprocating engines; and 3) hydrogen gas turbines (new and as retrofits to existing gas turbines). We have engaged with Plug Power, Caterpillar, and Power System Manufacturing (Hanwa) about technologies to get to 100 percent hydrogen and are encouraged by their plans, progress, and optimism that 100 percent hydrogen reciprocating engines and gas turbines will be available. Also, fuel cell operating performance is expected to improve, and costs are expected to decrease. In addition, Obsidian has established a Hydrogen Combustor Working Group to become informed on the state of hydrogen-fueled generation. The Working Group includes Avista, Calpine, Grant PUD, PacifiCorp, Perennial, Portland General Electric, Power System Manufacturing – Hanwa, and Puget Sound Energy.

B. Timeline. The Obsidian team, in coordination with key regional stakeholders, construction partners and long-term financing sources will undertake project planning and management and lead the deployment of capital in connection with measurable project milestones. We have identified the following development activities in the four phases of the DOE funding for the Hub as shown in Table 2:

[15] PNHA is a non-profit, public-private partnership formed by the Washington State Department of Commerce to apply for and administer H2Hub funds. Though not able to coordinate our two concept papers for submission, we expect this Hub and the hydrogen plans described by PNHA would be combined into a single application for grant funding.

Table 2 Preliminary Development Plan, Timeline, and Use of Funds

Dev. Cost (millions)	Total Cost (millions)	DOE Funding Request	Description	Phase 1* 2024-2025	Phase 2** 2025-2027	Phase 3 2027-2030	Phase 4 2030-2033
$20	$1,200	$0	1.2 GW of new solar generating facilities, approximately half in WA and half in OR				
$20	$1,200	$0	1.2 GW of new wind generating facilities, approximately half in WA and half in OR				
$3	$1,600	$30	1.2 GW of electrolyzers with an estimated development cost of $400,000 for each location (estimated 8 locations)		$5	$15	$10
$4	$3,600	$140	6,000 MT of H2 gas storage in long-duration underground storage manifolds, co-located with solar in most cases, up to 8 locations at $400,000 in manifold development cost per location and an estimated $600 per kg in procurement and construction costs		$15	$65	$60
$30	$600	$60	Stage 1 storage/ interconnection pipeline of approximately 200 miles			$60	
$60	$1,600	$120	Stage 2 storage/ interconnection pipeline of approximately 360 additional miles			$30	$90
	$150	$50 [1]	Development and Support of Use Cases and Supply Opportunities for Hydrogen for Last Mile Packages (two-thirds expected for transportation)		$50		
	$60	$50 [1]	Development and Support of Use Cases and Supply Opportunities for Hydrogen at Ports and Airports (largely for transportation)		$5	$20	$25
	$60	$50 [1]	Development and Support of Use Case and Supply Opportunities for Hydrogen Involving Tribal Projects (Last Mile Package and Other)	$10	$5	$15	$20
	$75	$50	Community Outreach, Develop and Implement Community Benefit Plan, including Workforce Training, Apprenticeships, Recruiting, Encouraging Minority-Owned Business Participation, and similar activities	$3	$5	$32	$10
$30	$100	$50	Preliminary Engineering and Corridor Evaluation for Stage 3 Pipeline segments to Spokane and Lewiston			$25	$25
	$200	$50	Enhanced Mitigation Activities (aggressive utilization of wastewater for project activities, conservation of affected resources, creative uses of reject heat and water; finding a use for oxygen produced by electrolysis; aggressive recycling programs; end of life programs)	$5	$10	$20	$15
	$50	$50	Grant Administration, Auditing, and Reporting	$2	$10	$19	$19
$167	**$10,495**	**$700**	**TOTAL**	**$20**	**$105**	**$301**	**$274**

* limited to $20M DOE Funding

** limited to 15% of total DOE Funding

[1] These packages together have a greater than 50 percent match

V. Impact of Hub on National Production and Consumption Infrastructure. The advantage of regional hydrogen hub infrastructure projects linking together is less to enable delivery of hydrogen from one region to another, but rather to create additional capacity so that surpluses and shortages of hydrogen can be effectively shared. Being interconnected makes the whole system more consistent, more reliable, and more secure. Despite its natural isolation by mountain ranges, two features of the Hub advance this outcome. First, the Hub can be readily expanded toward other national hydrogen hub infrastructure systems incrementally, in a modular fashion. Second, the Hub supports a wide variety of end users, which increases the Hub's expansion opportunities. Another impact of the Hub on national production and consumption is the ability to replicate its ideas and experience across the country, particularly around diesel fuel replacement and new firming hydrogen power plants. Our Hub will expand to the Portland and Seattle load centers but uncertainty about transmission and the difficulties of building new transmission lines over the Cascade Mountains has led us to conclude that we cannot at this time be confident that expansion into Portland and Seattle can occur within 10 years. The lack of available transmission west of the Cascades all along the Interstate-5 corridor make it difficult and expensive to produce green hydrogen with traditional utility tariffs. We are satisfied that the utilities along that corridor cannot provide hundreds of megawatts for electrolyzers using the existing transmission system.

A. Total Hub Capacity. When fully developed by 2032, the Hub will have the capacity to produce 525 MT per day of hydrogen and have a total storage capacity of 6,000 MT. That is sufficient storage to supply the expected average consumption level (368 MT per day) for two weeks.[16] Over time, the modular nature of the Hub will permit it to grow much larger. The Hub will advance hydrogen production and consumption in the United States through the diversity of applications unique to our region and the extension of hydrogen to industrial and agricultural processes that have a carbon impact that is difficult to reduce.

B. Hydrogen Cost, Efficiency, and Market Analysis. The Hub's expected production cost of hydrogen is less than $1.00 per kg after application of the $3 per kg production tax credit, and the cost of storage and delivery is $1.50 per kg +/- 25% for a total cost of hydrogen delivered to end use customer of $3 per kg.[17] Cost efficient production and delivery of hydrogen from the Hub is achieved by installing efficient solar and wind energy production equipment at large sites with favorable conditions, and directly connecting the resulting in low-cost renewable energy with equivalently scaled electrolysis facilities. Obsidian has considerable experience developing solar and looks to partner with Vestas for wind development dedicated to the Hub. We expect the wind and solar to be available under long term fixed price agreements, providing price stability for the hydrogen produced. There is a great deal of solar and wind development in the region and new supplies are expected to be available in a timely manner and at a competitive cost.

[16] Estimated average production of 70% of the 525 MT/day capability from solar, wind and opportunistic renewable energy purchases in the market: 368 MT/day. Dividing 6,000 MT of storage by 368 is 16 days of storage.
[17] Estimate is based on expected cost of power, hydrogen production levels, estimated capital costs of electrolyzer, storage, and pipeline and accounting for tax treatment. Recent commodity price movements (electrolyzers have been dropping, piping rising) add to the uncertainty of the estimate. A substantial amount of cost is related to the storage manifolds, whose size can be adjusted somewhat as necessary.

Direct connection to the electrolyzers avoids costs and high potential for project delays when interconnecting to the regional power grid. The available wind and solar resources are expected to provide a combined project average capacity factor at the electrolyzers of 50-55 percent.[18] With selective purchasing of renewable power when needed from wholesale markets, the capacity utilization factor at the electrolyzers should exceed 67 percent.[19] The pipeline delivery network, while capital intensive to establish, delivers significant long-term savings over alternative methods of transport. Potential high volume hydrogen markets in the Northwest include power production and ammonia manufacturing. Northwest agriculture uses nitrogen fertilizers representing nearly 500 MT per day of hydrogen, imported from outside the region, principally from Alberta[20]. Gas turbines in the vicinity of the Depot anchor site produced a total of more than 12 million MWh of electricity in 2020[21], representing a hydrogen market potential of 150 MT per day of hydrogen with 30% hydrogen blending (by volume), and 1,500 MT per day at 100% hydrogen. New small hydrogen firming generators add to that total by a potential of another 250 MT per day.

VI. Impact of DOE Funding on Proposed Project. DOE Funds awarded to the Hub will extend access to renewable hydrogen for energy security and economic diversification to energy burdened and dependent communities across a larger geographic area, enabling the project to include a greater number of last mile projects, which are not otherwise economically feasible, to support a variety of features in our community benefit plan.

A. Expansion to the CTUIR, to Lewiston, Idaho and to Spokane, Washington. Less economic segments of the Hub may not be developed without an award of DOE funds. For example, once the main pipeline reaches Pendleton, Oregon, it is only about 9 more miles to build toward the CTUIR's reservation lands. However, the economics of bringing the hydrogen to that area are difficult without DOE funding. Similarly, DOE funding would enable the Hub to extend the main pipeline toward Lewiston, Idaho and Spokane, Washington. Expanding to these regions requires long lengths of infrastructure to reach lower current hydrogen demand, but they offer are potential connections to adjacent regional hubs being developed in Montana, Utah (and through Utah, to California).

B. Use Cases that Require Subsidy Pending Market Growth. Bringing hydrogen "the last mile" from the Hub's main storage pipeline to smaller volume end users becomes economically viable when customers are geographically clustered, and demand is aggregated to support pipeline capital expenditures. In the short term, deploying DOE funds to support development of hydrogen in the small business community and in coordination with other regional stakeholders

[18] Based on an in-house analysis of hourly wind and solar production near the Depot, accounting for hours of overlap where some curtailment may need to occur.

[19] Northwest hydropower system operations for mitigation impacts to fish regularly result in large surpluses during the spring snow-melt months (April - July), especially at night when power demands are low. These periods when wholesale market prices are low can add another 15-20% of power to electrolyzers as opportunistic power purchases.

[20] Carbon Neutral Consulting research for this paper from various government/corporate publicly available data.

[21] US Environmental Protection Agency eGrid data.

will be critical to growing hydrogen end users further afield from the main pipeline. Collectively, these stakeholders and customers can make clean hydrogen via pipeline a viable, long-term cost-competitive energy alternative. DOE funding will finance the required engineering work, environmental studies and permitting, equipment and installation costs, and connective infrastructure required for last mile customers to tap into the Hub's storage pipeline.

C. Community Benefits. The DOE funds will support the following initiatives consistent with our Community Benefits Plan:

- The development of local apprenticeship programs that create opportunities for skilled training and long-term employment opportunities in the rural areas in which the Hub will operate, including through at Big Bend Community College near Moses Lake Washington and Blue Mountain Community College near Hermiston in Oregon. Special outreach to Tribes, low-income students and veterans will be part of these programs.
- Early educational outreach in local high schools in collaboration with groups such as the Bonneville Environmental Foundation to supply renewable hydrogen curriculum kits, union pre-apprenticeship programs, Girls Build summer and spring break camps and other events tailored to local resources, needs and opportunities.
- Contributing to the successful implementation of the CTUIR Energy Vision: To create an energy future where independence and reliability maximize tribal sovereignty, affordability, and access for the Umatilla Indian Reservation community in a manner that respects Tribal law, protects, and enhances treaty-reserved resources, and is consistent with the CTUIR Comprehensive Plan.
- Direct support of stakeholder engagement processes that meet Justice40 Initiative goals for involvement of organizations representing historically disadvantaged communities in project shaping, planning and ownership.
- Construction planning minimizes the negative impacts and multiplies benefits to the farming and agricultural land use and on lands owned and occupied by historically disadvantaged communities.
- Providing periodic and regular environmental studies to measure hydrogen adoption and related emissions reduction in the region as well as the impacts of infrastructure on the natural environment and correlated socio-economic research and reporting on the net impact of the Hub on the region generally and communities that have historically been disproportionately adversely affected.

VII. Hub Meets FOA Objectives. Consistent with the FOA objectives of jumpstarting a clean hydrogen economy, this project delivers hydrogen solutions to sectors and end users that have significant long-term stable demand for hydrogen. Within the region served by our Hub, this includes data centers, semi-conductor manufacturers, green fertilizer production facilities, and fuel for transportation. End users in these sectors will lead adoption of hydrogen use in Oregon and Washington and justify longer-term private sector funding that leverages the government funded hub development and amplifies its economic impact across communities. Specific economic development impact goals for the Hub and adoption of hydrogen use in the region include:

1. Timely development of over 500 miles of storage and pipeline infrastructure across Oregon and Washington designed to expand in both production, capacity, and geographic reach over time in a modular fashion, with sufficient flexibility in infrastructure design to accommodate a diverse set of industrial end users and applications for hydrogen use.
2. Measurable adoption of clean hydrogen production and delivery and correlated improvements in the fully delivered cost of hydrogen to customers below $3/kg.
3. Prioritized delivery of hydrogen supply to otherwise difficult to abate manufacturing processes and quantification of the reduction in natural gas use and diesel consumption.
4. Measurement of private sector capital funding to renewable energy infrastructure and hydrogen production facilities that leverage the base of federally funded infrastructure.
5. Direct involvement of organizations that represent disadvantaged communities in the project planning and implementation stages.
6. Formation of an internship program, pre-apprenticeship, and apprenticeship and long-term job training programs that directly benefit historically disadvantaged communities.
7. Funding of data collection, reporting and evaluation programs to track jobs created in construction and ongoing maintenance of infrastructure and job and wage growth at Hub connected companies.
8. Tracking community investment and steering improvement in impact on disadvantaged communities contemplated by our community benefits plan.

VIII. Long-Term Financial Viability. The Hub's long-term viability and impact is secured by the financial sustainability of the project model: cost efficient and reliable renewable energy sources, clean hydrogen production facilities of significant scale, and strong anchor tenants underpinning long-term stable demand. Additionally, regional hydrogen infrastructure development is supported by the long-established clean energy ecosystem and very strong public policy in our region that supports rapid adoption of hydrogen. Scaling the hydrogen ecosystem to a critical mass of diverse end-uses is achieved through the combination of federal funding and a Hub infrastructure roll-out that is intentionally designed to overcome the timing problem of costly patchwork development. The Hub makes hydrogen available by storage pipeline to varied end users. High-volume end demand from a fertilizer producer, for example, and the capacity payments from the data centers will provide a strong financial foundation for the storage pipeline from the start. That foundation can help justify fueling station development for transportation that would otherwise be difficult. As transportation fleet owners join the ecosystem, the scale of hydrogen production will increase, and hydrogen prices for end users will decline with increased utilization and economies of scale of storage. Looking forward, scaled up adoption and related reductions in the marginal cost of production will make hydrogen an economical clean energy source in more applications. Further, the broader customer base will lower the risk of future private sector investment in renewable energy development and hydrogen infrastructure connected to the Hub, allowing the expansion to be bankable.

The Hub is designed to encourage and easily accommodate follow-on funding from the private sector. The modular nature of the Hub means that if a small new user wants hydrogen service it only needs a last mile package to be accommodated along the entire reach of the pipeline. We

expect these would be financed in a manner like other new utility hookups today. If a large new user wants hydrogen service along the reach of the pipeline, the Hub will add more renewable energy generation and perhaps another electrolyzer and storage manifold in the general proximity of the new user. The Hub should be able to accommodate new users along the entire reach of the pipeline without a need for additional funding from the Department of Energy.

The physical reach into other regions outside the Pacific Northwest will require a use case that is not yet apparent. Natural gas is shipped from Alberta Canada to San Diego because it must be. There are no gas fields along the line to supplement the supply of natural gas from Canada. Hydrogen will not likely be shipped from Texas to the Pacific Northwest or to California or from North Dakota to the Pacific Northwest because cost competitive hydrogen can be built in the Pacific Northwest. Interconnecting the Hub with pipelines and hubs in California and Utah would improve the reliability and resiliency of all systems, but interconnection does not seem necessary to provide an adequate supply. And the crossings required for interconnection pass through mountain ranges, wilderness areas, sensitive lands, and sensitive Native American areas. While national interconnection seems very likely to occur in the East and Midwest, it will likely come outside the 10-12-year window of the grant in the West.

IX. Community Benefits Plan. Our approach to meaningful community engagement involves engaging partners where they convene, such as council, commerce, and commission meetings, as well as direct outreach through curated events designed to expand audiences and engagement of the broader community in hydrogen education. This provides input into the Hub design, development, and ownership models. We regularly attend CDA board meetings (near the Depot anchor site) to listen to and understand local obstacles and opportunities. We engage one-on-one with Tribal, elected and labor leaders to shape project elements reflecting local priorities and aspirations. We complement leadership conversations through partnerships with local and regional community outreach organizations, including Community Renewable Energy Association (CREA) and Sustainable Northwest. Developing and maintaining collaborative engagement and outreach relationships with local community organizations, tribal networks, labor boards and community colleges, is part of the Hub's core mission and value structure.

We have engaged in substantial work to identify diverse users, understand local priorities, and broaden participation in the Hub. In 2022, the Hub held outreach and education meetings along the proposed pipeline route in Boardman and Pendleton, Oregon, Richland and Moses Lake, Washington. We provided potential hydrogen users information about the Hub's opportunities and introduced the "last mile package" to interested stakeholders. As a result of these meetings and other outreach, the Hub received indications of interest or support from the Port of Moses Lake, the Ports of Wenatchee and East Wenatchee, the Port of Quincy, the Columbia Development Authority, the Confederated Tribes of the Umatilla Indian Reservation (CTUIR), the Oregon State Building and Construction Trades Council, and the Washington State Building and Construction Trades Council, AFL-CIO. DOE Funding will enable the Hub to continue these efforts,

expand our reach, and enable inclusion of broad geographically and economically diverse participants.

- We are engaging with the CTUIR to better understand their interest in owning or co-owning projects, specific siting concerns, worker training and economic development opportunities for tribal members; and are proposing several joint development ideas consistent with the CTUIR Energy Vision. The CTUIR needs development funding to best participate.
- We are exploring potential partnership opportunities and/or a preferential contactor agreement with CSF Energy Group. CSF is a collaborative project management and consulting group founded by Donald Eagle Williams, an enrolled Umatilla Tribal Member. Its mission is to help Native Tribes and other clients in the Pacific Northwest and beyond achieve their energy generation, conservation, and independence objectives to help create sustainability that lasts for generations.[22] CSF (as a start-up business) would make good use of DOE funding to best participate.
- We are advised by Sustainable Northwest, Bonneville Environmental Foundation, and CREA.
- The Obsidian project and much of our project capital will be spent in census tracts that are disadvantaged (see Figure 1).
- Several parts of our Hub target a reduction in burning diesel, which disproportionately affects the targeted groups. Those parts include diesel backup generators, diesel on the farm, diesel trucks, and equipment at ports and airports. DOE funding would enable the Hub to replace more of these diesel generators sooner in a cost-effective manner.
- We will create a lot of well-paying jobs that meet prevailing wage and union requirements. In 2021, the Oregon Legislature passed a bill establishing Responsible Labor Standards requirements for developers, contractors, and subcontractors of large-scale energy projects of 10 megawatts or greater in Oregon. The Washington Clean Energy Transformation Act supports provides tax incentives through 2029 for clean energy projects that employ women, minority, or veteran-owned businesses, and employers who hire local workers or offer apprenticeship programs.
- We will have detailed workforce training and recruiting plans with the unions and with local community colleges and are committed to robust apprenticeship programs with a focus on local hiring. We will recruit in the area with a focus on engaging people who are disadvantaged. DOE funding would allow this recruiting effort to expand.

A. Meaningful Community and Labor Engagement. We have an important partner in the CREA, an intergovernmental association whose members include irrigation districts, councils of government, project developers, for-profit businesses, and non-profit organizations.[23] Additionally, our MOUs with the Oregon State Building and Construction Trades Council and the Washington State Building and Construction Trades Council, AFL-CIO, formalize our collaboration in community outreach and local workforce development. Our outreach and engagement activities have included not just community stakeholders and labor leaders. We have provided briefings to the Oregon Public Utility Commission, and to local utilities including Portland General Electric and Grant PUD, each of whom are exploring how their own hydrogen initiatives can be

[22] https://www.csfenergy.com/about-us/
[23] https://www.community-renewables.org/home

advanced within the Hub. Through the Steering Committee and other outreach efforts, the Hub has the support of these important partners: Sustainable Northwest, the Bonneville Environmental Foundation, the CDA, and the Renewable Hydrogen Association, to name a few. We also have the support of the Oregon Department of Energy and Business Oregon.

B. Investing in the American Workforce. Obsidian's model prioritizes energy sovereignty and workforce development for the Tribes upon whose territories and inhabited lands the Hub spans. Our approach is to engage early and often with Tribal and labor leaders to leverage the clean energy transformation for diversification and strengthening of the rural, American workforce. We have initiated and maintained active, collaborative discussions with organized labor leaders in Washington and Oregon to provide an overview of the project components and vision, invite input and develop a MOU on our agreement to pursue Project Labor Agreements, collaborate on workforce development through apprenticeships, prioritize local hiring and explore opportunities to uplift and support local, unskilled labor. We have also initiated relationships with Big Bend Community College in Moses Lake and Blue Mountain Community Colleges near Hermiston and plan to work with them in developing workforce training.

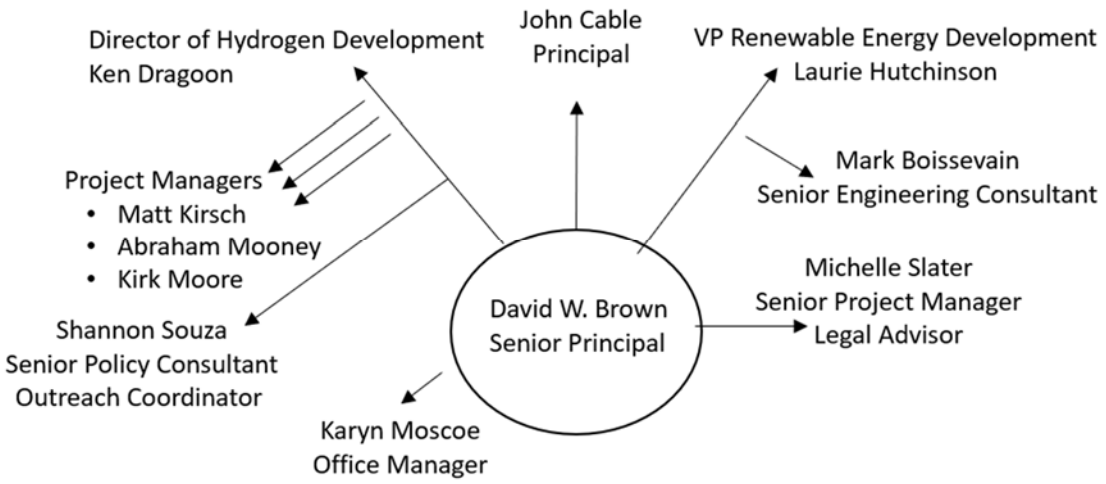
C. Advancing Diversity, Equity, Inclusion and Accessibility. In our approach to Hub development, we are intentionally focused on expanding access to clean, secure energy resources and diversifying career opportunities for underserved, rural communities through collaboration. An early example of the collaborative nature of the project is that an early layout of the pipeline was significantly altered after consultation with a Tribal organization that voiced concerns. We seek to identify and establish preferred contractor agreements with other Tribal, minority and women owned businesses to perform planning, development, operations, and ownership roles in Hub components throughout the served geography. As Hub elements solidify, we will work with our Tribal and labor partners to expand outreach, apprenticeship and support for transitioning workers and their families. At the core of the Hub, Obsidian's leadership and senior advisory team feature two Woman Owned Businesses, one of which is also located in a rural HUD zone.

D. Contributing to Justice40 Initiative Goals. The geography of the Hub intersects multiple agriculturally based communities and adjacent Native American territories. The Hub has major focal points in two areas, Hermiston, Oregon and Moses Lake, Washington which each benefited from large historic investments from the military that have ended. The Hub development and construction plan has been designed to leverage the specific attributes of these sites for direct local gain. The Hub benefits include access to direct ownership in energy and hydrogen infrastructure developments, job creation and workforce development, increased public and tribal lease and tax revenues, and economic diversification in the region. Additionally, access to clean hydrogen, new sources of electricity, clean burning fuels for heavy equipment, transportation and backup generation, and local fertilizer production will significantly strengthen the energy independence, and economic resiliency of both farmers and industrial work forces.

X. Project Team. The Obsidian team has considerable experience designing, developing, and completing utility scale solar projects. We built the first PacificCorp in-front-of the meter solar

project in 2012, the first solar project for Portland General Electric and the first utility solar project interconnected into the Bonneville Power Administration system, all in 2012. We have designed, developed and are ready to build the largest solar project in the Pacific Northwest (400 MW). The Project Team will be expanded beyond Obsidian before the grant application is submitted. We have discussions well underway to form a joint venture that includes Solv Energy (formerly Swinerton Renewable Energy), Perennial Power, a Sumitomo company, Power Systems Manufacturing and Q-Cells, both Hanwa companies, Vestas, a wind turbine, and wind development company that has expanded into green hydrogen, Coffman Engineers, Deloitte for accounting, financial analysis, and grant reporting, Norton Rose law firm, and others. The pipeline and manifold systems will be built by an experienced pipeline company, and the pipeline will be operated by an experienced and well-funded pipeline operator. The joint venture will be the applicant for the grant. Obsidian has in-house engineering, project management expertise and extensive experience with development and construction of projects supported by public private partnerships, state and federal tax credits and private capital investment. Obsidian will have a key part of the joint venture, but the actual structure of the joint venture is still being worked out as we learn who will fill what roles. The Obsidian team has considerable experience working together (Figure 5). The five senior people, plus our office manager, have worked together an average of more than 15 years. We have worked closely with SOLV Energy for more than 12 years, with whom we have built seven projects. Obsidian's relationship with Perennial goes back about 8 years working on regional energy policy. David Brown has had a professional relationship with Keith Martin of Norton Rose for more than 25 years.

Figure 4 Organization Chart



David W. Brown, Senior Principal, serves as the Team Lead for the Hub project. He provides overall project direction and fiscal management, strategic planning oversight, and serves as community liaison. He holds bachelor's and JD degree and has developed many of the larger utility scale solar photovoltaic projects in Oregon. David is a member of many regional renewable energy organizations and is very active in renewable energy incentive and land use legislation in Oregon.

John Cable has over 20 years of experience in finance, capital formation, business development and project management. He is experienced with debt and equity capital raises, project financing, venture investment, and private equity backed acquisitions. John leads fiscal management and strategic oversight of the Hub development. John has a B.A. (Economics) and an MBA.

Ken Dragoon, brings 40 years of power industry experience and provides a deep background in the Northwest energy industry, especially relating to challenges of accommodating variable renewable resources on the grid. He authored: *Valuing Wind Generation on Integrated Power Systems*, Elsevier, 2010; coauthored *Towards 100% Renewable Energy Systems,* Energy Policy, 2016; and *Hydrogen as Part of a 100% Clean Energy System*, IEEE Power & Energy Magazine, 2022, among others. He is a nationally known expert on hydrogen in power systems, and founder and former executive director of the Renewable Hydrogen Alliance. He provides the project an energy systems perspective, technical oversite, direction, and industry contacts.

Laurie Hutchinson manages all development aspects of the purpose-built renewable energy facilities for the Hub – working with landowners, permitting, interconnection, coordination with the engineering, procurement, and construction contractors. She leads Obsidian's efforts in solar site acquisition and permitting and is our liaison to local communities. Laurie has been in the solar industry since 2007 and is very active in regional renewable energy organizations.

Michelle Slater is provides legal and project management support to Obsidian and the Hub project. She has more than 25 years of experience including with complex commercial and regulated transactions, mergers and acquisitions, and renewable energy development.

Mark Boissevain has more than 10 years' experience in renewable energy and storage, half of that with SOLV Energy. Mark led SOLV's technical services team in commissioning over 3 GW of solar, wind and BESS facilities. For Obsidian, Mark supports greenfield design, transmission, and interconnection. Mark has an M.E (Electrical Engineering) and B.S. (Mechanical Engineering).

Obsidian's project developers are **Matt Kirsch, Abraham Mooney, P.E.,** and **Kirk Moore.** Matt provides overall hydrogen team support, grant writing, research, and financial modeling. Matt has a B.S. (Chemical Engineering). Abe provides engineering, construction, and project management support. He received a B.S. (Mechanical Engineering) and a M.S. (Ecological Engineering). Abe oversees the current engineering work on storage manifold design and the last mile package and community outreach efforts. Kirk, also a financial analyst, focuses on real estate, contracting, financial modeling, and project diligence. Kirk supports the Hub's land use, financial analysis, and modeling. Kirk has a B.S. and J.D.

Shannon Souza is a licensed professional mechanical and environmental engineer and water rights examiner and practices water resource planning, permitting, and development, and is a policy advocate for renewable energy. She supports Hub planning, policy, community integration, and outreach.

Karyn Moscoe, Obsidian's "do-everything" Office Manager, has been with Obsidian since 2005.