EXPANSION ENERGY

White Paper on the Patented "VPS™ Cycle" Technology

Utility-Scale & Commercial-Scale

Power Storage & Power Generation via Liquid Air Production

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I. Background

A. The Need for Bulk Power Storage

The need for large-scale, multi-hour ("bulk") power storage is growing in importance as increasing amounts of intermittent and fluctuating power from wind turbines, solar panels and other renewable sources are added to the grid. Large-scale (i.e., "utility-scale") power storage systems also allow surplus off-peak (i.e., nighttime or weekends) power from baseload power plants (e.g., nuclear, coal-fired and gas-fired combined cycle plants) to be stored overnight and delivered during the peak demand period the following day. In addition, smaller multi-MW energy storage systems (e.g., 2 MW to 50 MW) may provide a means to add peak power capacity to constrained load pockets at high net efficiency while helping to upgrade (and, in effect, expand) power distribution systems.

Without a way to achieve certainty of delivery during peak demand periods (also known as "firm" power), and without a way to store low-value off-peak power for release during high-value peak periods, the growth of intermittent renewable power sources may be constrained, keeping renewable power sources from reaching their full potential as part of the world's overall power generation portfolio. A further disadvantage of intermittent power sources such as wind is that they can cause system "balance" problems if allowed onto the transmission grid, which is a major hurdle for new (particularly renewable) power generation sources to clear. Thus, there is a clear need for efficient, predictable energy storage systems that are cost-effective to deploy on a multi-MW scale.

In addition to making renewable power more viable, cost-effective bulk power storage solutions that can release power during peak demand periods substantially increase the value of existing baseload (mostly non-renewable) power generation assets because power producers can typically charge significantly more for power sold during the day versus selling it during the night. Moreover, such a storage system diminishes the need to add new baseload coal or nuclear power capacity to meet growing power demand (because their off-peak power could serve on-peak periods). It also lowers the overall consumption of fossil fuels and nuclear fuel by producing more "usable" kilowatt-hours of power per unit of fuel consumed to produce the power, contributing significantly to the reduction of air pollutants, carbon emissions and hazardous/radioactive waste that result from today's baseload power plants.

Another significant issue of existing power systems is that transmission lines often become "clogged" or overloaded (particularly as it relates to transmitting intermittent power, like wind power), and transmission systems can become unbalanced. One existing solution for overloaded transmission lines is transferring power by "wheeling" (delivering of a specific quantity of power to each end-user), allowing any "power product" to enter the power transmission system and be used to "balance" any other product that was removed from the system. A disadvantage of using current power systems for wheeling is that power production occurs during all hours (most of which are not peak demand hours), and does not substantially overlap with peak demand hours. Another disadvantage is that transmission of power, which occurs at all hours (most of which are not peak demand hours), also does not substantially overlap with peak demand hours. Essentially, transmission lines today must be "overbuilt" to accommodate peak periods. Thus, there is a need for energy storage systems that can help to alleviate the problem of transmission lines becoming overloaded by allowing power to be stored at any point between the generator and the end-user, allowing the power to be moved across transmission systems during off-peak transmission periods (such as at night) and thereby reducing the power "traffic" that moves across transmission lines during peak demand periods.

Energy storage systems also benefit two important trends in the electrical system: (i) microgrids and (ii) resiliency.

Expansion Energy's patented **"VPS™ Cycle"** for bulk power storage and generation is a cost-effective, highly efficient technology that solves the issues raised above as well as addressing numerous other market needs for power production, storage and transmission/distribution. In addition to grid/utility applications, the VPS Cycle is also suitable for "behind-the-meter" deployments by large commercial and industrial power consumers.

B. The Benefits of Bulk Power Storage

Bulk power storage brings substantial benefits to the electrical system—to grid operators, to utilities, to rate-payers and to other stakeholders. The following table is a partial listing of the benefits of bulk power storage, adapted from the New York State Energy Research & Development Authority (NYSERDA).

Table 1: Benefits of Bulk Power Storage

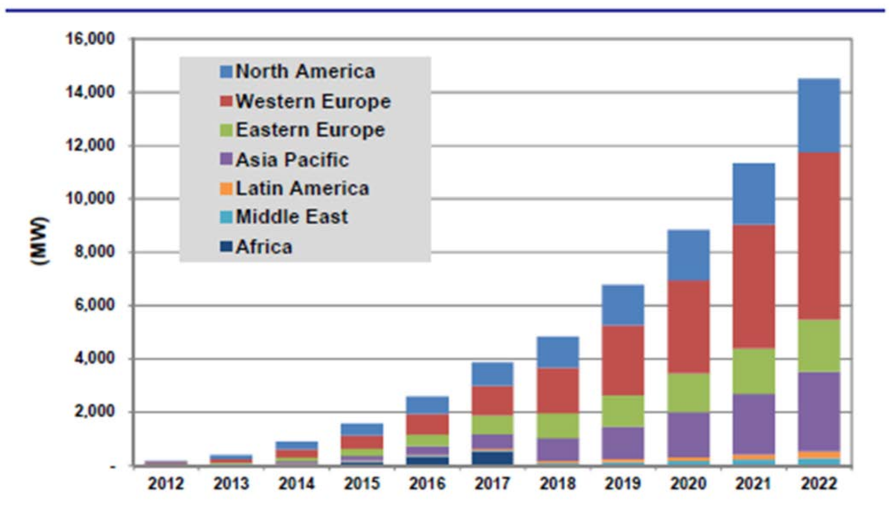
1	Electric Energy: Buy Low (off-peak), Sell High (peak)
2	Electric Supply Capacity
3	Eliminates the Need for "Peaker" Power Plants
4	Reduce Transmission Capacity Requirements
5	Reduce Transmission Congestion
6	Transmission & Distribution Upgrade Deferral/Displacement
7	Operating Reserve
8	Regulation and Frequency Response (Regulation)
9	Transmission Support
10	Electric Service Reliability
11	Electric Service Power Quality
12	Electric Service Bill Reduction: Demand Charges
13	Electric Service Bill Reduction: Time-of-use Energy Prices
14	Renewable Electricity Production Time-shift
15	Renewables Capacity Firming
16	Energy Storage Tax Credits (as available)
17	Carbon Credits (as available)
18	Transmission & Distribution Line Losses: Energy
19	Transmission & Distribution Line Losses: Capacity
20	Goodwill / Public Relations

Depending on where and how it is deployed, the VPS Cycle can deliver nearly all of the storage benefits listed in Table 1.

C. Market Opportunity

The VPS Cycle represents a multi-billion-dollar revenue opportunity for VPS technology licensees—both at "Utility Scales" (20 MW to 100's of MW) and "Commercial-Scale" (2 MW to 20 MW). The market for bulk power storage is projected to grow fast, as shown in the chart below from Navigant Research.

Figure 1: Global Bulk Power Storage Market Projection



Source: Navigant Research

Based on Navigant Research's MW projections, Expansion Energy estimates a total annual addressable market size of nearly $20 Billion by 2020.

II. Expansion Energy's Power Storage Technology: The VPS™ Cycle

Expansion Energy's "VPS™ Cycle", in its many embodiments, alleviates to a great extent the disadvantages of other bulk power storage systems. The VPS Cycle is a patented, highly efficient multi-MW power storage system utilizing liquefied air (L-Air) as the storage medium and a heat source as part of the power release phase. VPS is designed to operate on a daily cycle, storing energy during the overnight off-peak period and delivering 8-12 hours of power per day (at a constant release rate) during the grid's peak demand period.

The VPS™ Cycle patents include methods of storing power, energy release and replacement systems, and methods of providing firm power delivery. The VPS Cycle is patented in the US (US 7,870,746; US 7,821,158 B2; US 8,020.204; and US 8,063,511), Canada, Japan, South Korea and Australia, and is patent pending in other international regions.

Key characteristics of the VPS™ Cycle include the following:

- A highly efficient "distributed generation" power plant with storage built in
- Turns intermittent power sources (e.g., wind, solar) into "firm" power sources
- Also beneficial for storing baseload power (e.g., coal, nuclear, gas) off-peak
- VPS components are 100% commercially available ("off-the-shelf")
- "Round-trip efficiency" (RTE) > 95%
- 8 to 12+ hours of power release capacity—daily cycling, at a constant release rate
- Lowest capital cost per kWh (of daily capacity) of any bulk storage technology: $150-$275/kWh
- Can be constructed virtually anywhere above-ground
- Substantially reduces grid congestion if sited near high-demand end-users/load centers
- Ultra-high BTU conversion efficiency
    - ❖ Heat Rate = ~ 3,316 BTU/kWH (vs. 6,660-7,700 BTU/kWH for combined cycle plants)
- Fast start – less than 20 minutes to reach full outflow capacity (+ partial outflow faster)
- 10 X greater storage density than compressed air energy storage (CAES)
- Much higher RTE than CAES
- VPS is 100% man-made—reliable, predictable, replicable
    - ❖ No reliance on special geologic conditions/caverns
- Expected useful life of 40+ years

The VPS Cycle is neutral as to siting options, allowing it to be near the renewable power source (wind, solar, landfill gas, anaerobic digester gas, geothermal, etc.), near a baseload power plant, or near the load/end-user, including at commercial and industrial facilities. Thus, the VPS Cycle can enhance virtually all segments of the electric power industry. Utility-Scale (20 MW to 100's of MW) VPS deployments can achieve the goals of grid-level power storage more cost-effectively, more efficiently and with less siting constraints than any other option at similar scales. At smaller scales, Commercial-Scale (2 MW to 20 MW) VPS deployments can be viewed as **distributed generation + distributed storage** facilities. Optionally, liquid air (or liquid N_2 or liquid O_2) can be trucked to the VPS site from nearby air separation plants (instead of producing liquid air on-site).

The VPS Cycle is a new paradigm for power storage and generation, and has the potential to reduce the need for many large, centralized power plants—by serving applications on the grid, for microgrids and "behind-the-meter."

A. General Principles Behind the VPS Cycle

In its Inflow-to-Storage phase, the VPS Cycle aims to store a selected amount of liquid-air (L-Air), at optimal pressure and temperature conditions, over a specified daily period, with the least possible input of energy. This is achieved by the following:

- Establishing various pressure and temperature conditions for the stored L-Air, all of which allow for storage in existing "off-the-shelf" cryogenic storage tanks, and all of which can be pumped to high pressure by cryogenic liquid pumps

- Selecting an optimal balance between compression and refrigeration input to achieve the optimal L-Air storage conditions

- Recovering waste heat of compression to produce "free" refrigeration (i.e., through the use of absorption chillers) that can be applied to each stage of compression, thus reducing the total workload on the compressor motor; and/or

- Utilizing low-grade refrigeration as a "side load" from the mechanical chiller that provides deep refrigeration to the compressed refrigerant air stream, prior to the expansion of that refrigerant air in a compressor-loaded cryogenic turbo-expander.

In its Outflow-from-Storage phase, the VPS Cycle aims to produce the maximum possible power with the least possible burning of fuel, per the following techniques:

- Selection of the outflow pressure to which the released L-Air is pumped, based on the maximum pressure tolerance and pressure letdown ratio capacity of standard "off the shelf" hot gas expanders

- Recovery of the refrigeration content of the stored L-Air (prior to vaporization and combustion) by using that refrigeration to condense several working fluids that are also expanded in hot gas expanders, at the maximum pressure, temperature, and letdown ratio capacity for those secondary expanders

- Using a portion of the waste heat from the expanded products of combustion (produced after pressurized natural gas (NG) is combusted in the presence of pumped-to-pressure and vaporized L-Air) to heat the working fluids that are used to produce additional power, where the working fluids are condensed by the "cold content" in the outbound L-Air

- Using a portion of the waste heat available from the expanded products of combustion to pre-warm the vaporized (formerly) L-Air prior to its arrival at the combustion chamber

- Combusting the compressed NG + warm (high-pressure) air mixture at an optimal rate so as to create enough high-grade heat (in BTUs), allowing a portion of that heat to boil the working fluids and still yield a hot enough product of combustion to match the temperature capacity of the hot gas expanders

- Expanding the hot, high-pressure products of combustion and at least one of the working fluids in a two-stage-with-reheat expander configuration, optimizing the performance characteristics of high-pressure expanders with cooler inlet temperatures and low-pressure expanders with hotter inlet temperatures, thus producing more power with less energy input

The above outlined principles yield a VPS Cycle that offers the following significant benefits:

- Recovering the maximum power input (MWH) during the Outflow mode, yielding a Round-Trip Efficiency (RTE) exceeding 95%
- Achieving a high Thermal Efficiency (TE) because a large portion of the power output comes from the stored L-Air, which when derived from renewable power (e.g., wind) is produced with zero fuel use
- Reducing fuel use and CO_2 emissions per MWH of power output, particularly when a significant portion of the power used to create the L-Air during Inflow-to-Storage is zero-emission renewable power

The sections below describe VPS's Inflow-to-Storage and Outflow-from-Storage phases in greater detail.

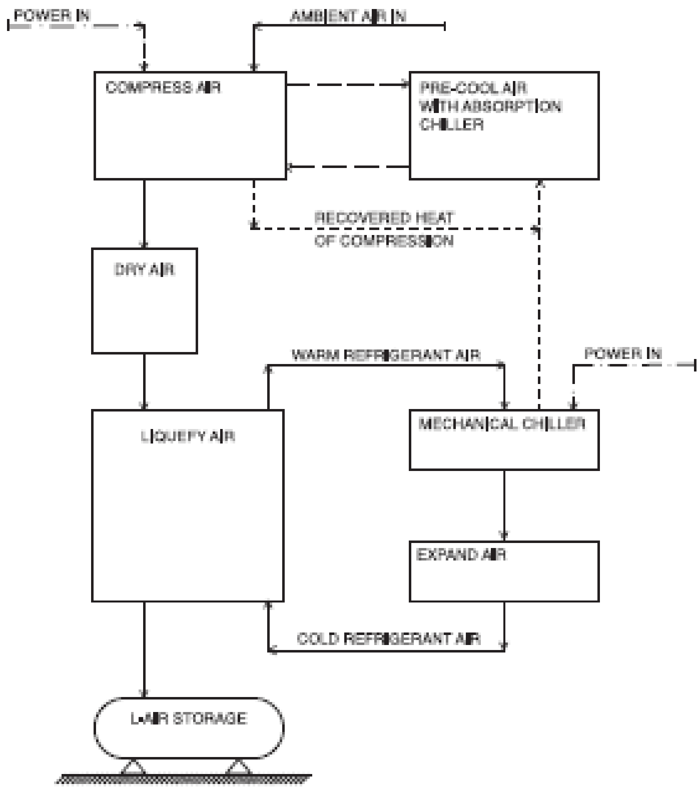
B. Power Inflow-to-Storage Phase

The VPS Cycle uses off-peak electric power to make liquid air, which is stored in a moderate-pressure cryogenic tank (or tanks). (The production and storage of L-Air is similar to the production and storage of other cryogenic liquids such as liquefied natural gas (LNG) and liquid nitrogen (L-N_2).) The "release" of the energy stored in the L-Air is discussed in subsequent sections.

The following are the basic process steps that occur in VPS's Inflow-to-Storage phase during off-peak power periods (e.g., overnight). These steps are also shown in Figure 1 below.

1. Water and CO_2 are removed from moderately compressed stream of inlet ambient air
2. The dry inlet air is mixed with recycled "refrigerant air," then jointly compressed to about 500 psia
3. Recovered heat of compression drives an absorption chiller
4. The absorption chiller acts as an inter-cooler and after-cooler to the compressor
5. Additional cooling of refrigerant air is achieved by a mechanical chiller whose waste heat also drives the absorption chiller
6. Deep refrigeration of the refrigerant air is achieved by a compressor-loaded turbo-expander(s)
7. The cooled, dry inlet air is liquefied by heat exchange with the deeply chilled refrigerant air, achieving **air-to-air liquefaction**
8. Liquid air is stored at optimal pressure and temperature in an L-Air tank(s)

Figure 2: VPS Cycle Inflow-to-Storage Phase



One embodiment of the VPS Cycle comprises directing ambient inlet air to a multi-stage integral gear compressor, which compresses the inflow air in reasonable steps. After the first stage of compression, the air is sent through a molecular sieve to remove CO_2 down to 50 parts per million and to remove any moisture content. The heat of compression is removed after each stage by way of an absorption chiller, which is driven by the hotter grade heat available at several of the compression stages. In turn, the low-grade refrigeration output of the absorption chiller helps cool the air stream before it enters the next stage of compression.

The compressor not only increases the pressure of the inflow air, but also compresses bone-dry air that serves as the refrigerant stream in the Cycle. Thus, a single compressor acts on "product air" (which will become L-Air) and on "refrigerant air" which liquefies the product air. After the final stage of compression (and heat-of-compression recovery), the bone-dry product air travels on to a main heat exchanger at approximately 75 psia, where it is liquefied. The counter-flowing refrigerant stream in that heat exchanger is the refrigerant air.

The refrigerant air flows through several of the same stages in the compressor that pressurize the product stream. However, the refrigerant air stream also moves through a mechanical chiller and through a compressor-loaded cryogenic turbo-expander. Deep (cryogenic) cooling of the refrigerant air occurs as a result of the work performed by the compressor load on the expander.

To summarize, in the VPS Cycle, the off-peak electric power to be stored is "converted" to L-Air by the optimum balance between moderate compression and cryogenic refrigeration, with several heat-recovery and cold-recovery steps. Those heat-recovery and cold-recovery steps serve to convert the maximum energy input into L-Air, but within thermodynamic and capital cost limitations. The resultant L-Air is stored at moderate-pressure in one or more cryogenic containers, ready for its role in the peak-period power Outflow-from-Storage phase described in the following section.

C. Power Outflow-from-Storage Phase

During the Outflow-from-Storage phase of the VPS Cycle, the stored energy (in the form of L-Air) is sent out as electricity (power) by converting the L-Air to hot compressed air, which can be expanded in a generator-loaded hot gas expander(s), or sent to a standard gas turbine (GT). The hot gas expander (connected to a generator) can be just that, or it can be a GT without a front-end compressor. In any configuration, the energy stored in the L-Air is released after the L-Air is pumped to pressure with a cryogenic pump, vaporized, heated by waste exhaust heat from the on-site GT and/or sent to a combustion chamber where it is further heated by the combustion of a fuel (such as natural gas or landfill gas (LFG), or anaerobic digester gas (ADG)), and then expanded in a hot gas expander (or the back end of a GT) which is loaded by a generator.

In short, a variety of configurations can be used for recovering the energy stored in the L-Air, including integrations with adjacent existing or newly constructed baseload power plants and with "peaker" power plants. In all cases, the dense L-Air is first pumped to pressure (with very little energy input, because liquids are virtually incompressible) and then vaporized by waste heat (much like steam in a steam cycle) and then sent to the combustion chamber of a GT or to a hot gas expander which are loaded by a generator on the same shaft.

The following are the basic process steps that occur in VPS's Outflow-from-Storage phase during peak power demand periods. These steps are also shown in Figure 2 below.

1. L-Air stored at optimal pressure and temperature is pumped to a high-pressure with cryogenic liquid pumps

2. Refrigeration content of pumped L-Air is used to condense two counter-flowing working fluids, which in turn vaporize the outbound air

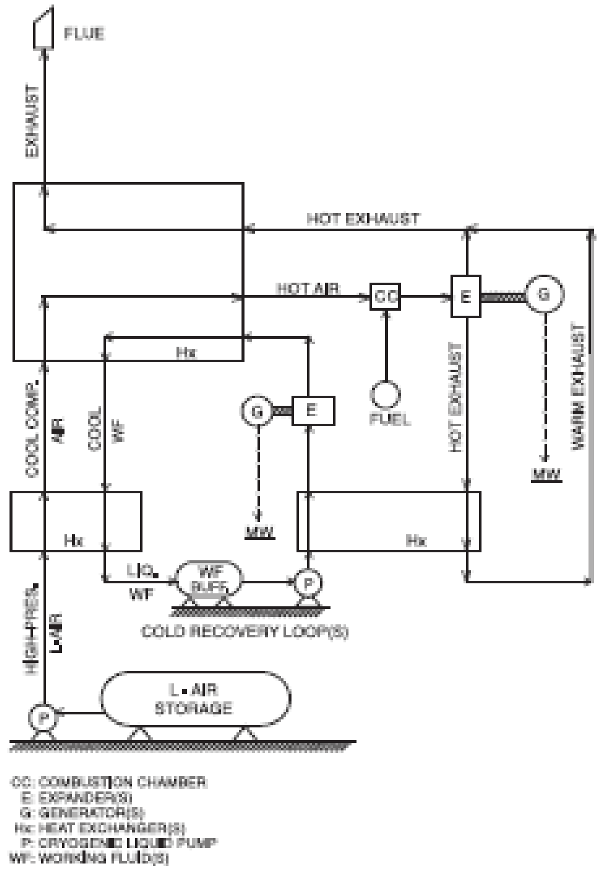
3. Vaporized, high-pressure air is combusted with natural gas, producing hot combustion gases

4. Hot combustion gases help heat the outbound air and heat the pumped-to-pressure working fluids

5. The somewhat cooled, high-pressure combustion gases are expanded in a multi-stage, generator-loaded hot gas expander, yielding about **40%** of the total net power output

6. The hot, high-pressure working fluids are also expanded in multi-stage, generator-loaded hot gas expanders, yielding about **60%** of the total net power output

Figure 3: VPS Cycle Outflow-from-Storage Phase



The refrigeration content of the L-Air that is sent toward the prime mover (as described above) is recovered in one or more adjacent "power loops." Those power loops are a unique innovation of VPS, serving to nearly fully recover the energy content of the outbound, stored L-Air. The refrigeration content of the L-Air is used to condense one or more working fluids (such as CO_2 or ammonia), which, like the L-Air, are pumped to pressure, vaporized by a portion of the same heat that vaporizes the L-Air, and then expanded in generator-loaded hot gas expanders. In that way, the VPS Cycle converts the L-Air into compressed air (by way of the cryogenic pump) and recovers/recycles its refrigeration content to condense one or more working fluids that operate as "bottoming cycles" under the air expansion portion of the VPS Cycle. In that sense, VPS is a unique application of well-known combined cycle principles, but without a steam cycle.

D. Main Components of the VPS Cycle

The VPS Cycle relies entirely on existing "off-the-shelf" components that are supplied by multiple qualified vendors globally. The main components of the VPS Cycle are described in the table below.

Table 2: Main Components of the VPS Cycle

<table>
<tr><th><u>Main Inflow-to-Storage Components</u></th><th><u>Main Outflow-from-Storage Components</u></th></tr>
<tr><td>• Multi-stage air compressor
• Molecular sieve
• Absorption Chiller
• Cryogenic refrigeration array
❖ Mechanical chiller and compressor-loaded cryogenic turbo-expander
• Main heat exchanger and smaller heat recovery exchangers
• Cryogenic (L-Air) storage tank(s) – shop-fabricated tanks may be used
• Instrumentation & program logic (automated)</td><td>• Cryogenic liquid pumps
• Cold recovery "loops"
❖ CO_2 and secondary refrigerants are condensed after vaporization & expansion by waste heat
• Main heat exchanger and smaller heat recovery exchangers
• Fuel gas compressor
• Combustion chamber
• Generator-loaded, multi-stage hot gas expander
• Instrumentation & program logic (automated)</td></tr>
<tr><th colspan="2"><u>Liquid Air Storage Tanks in Gallons (for 8 hours of Peak-Period Output)</u></th></tr>
<tr><td>• 10,000 G = 2 MW
• 20,000 G = 4 MW
• 40,000 G = 8 MW
• 75,000 G (largest shop-fabricated tank) = 15 MW</td><td>• 150,000 G (2 shop-fabricated tanks) = 30 MW
• 225,000 G (3 shop-fabricated tanks) = 45 MW
• 1,000,000 G (1 field-erected tank) = 200 MW</td></tr>
</table>

E. VPS Efficiency Features

The VPS Cycle achieves its storage goals by increasing the density of ambient air to the density of liquid air. The increased density substantially reduces the air's volume, allowing for its storage in moderately sized containers. The density increase achieved by cooling the air surpasses the density-increasing effect of compressing air if the two systems are compared to each other on the basis of total energy input relative to density achieved. In other words, on the basis of energy input relative to density achieved, refrigeration will more efficiently increase the density of air. This results from the fact that a balance of compression and chilling can be achieved by recovered heat and recovered cold—as compared to compression alone, where heat recovery is possible but not practical, and where no refrigeration exists.

The wide temperature range of the VPS Cycle—from approximately -230° F (during Inflow-to-Storage) to approximately 2,000° F (during Outflow-from-Storage)—allows each heat source and refrigeration source within the Cycle to be more fully utilized by heat/cold recovery steps in the process. For example, in the VPS Cycle, the heat of compression during Inflow-to-Storage is an energy source for VPS's absorption chiller, which helps pre-cool the inlet air to each stage of compression. Similarly, the heat of compression that would normally be a parasitic loss in the mechanical chiller and in the compressor that loads the cryogenic expander is also recovered and sent to the absorption chiller. In that way, with "free" energy driving the absorption chiller, less energy is needed by the main refrigeration system.

Almost all of the heat content of the GT (or combustion chamber) exhaust is recovered and used as the final pre-heating step before the compressed air arrives at the combustion chamber. With such pre-warming of the inlet air prior to its arrival at the combustion chamber, less fuel is consumed to achieve the temperature needed by the hot gas expansion turbines for expanding the hot exhaust gas that is the product of the combustion of the air and fuel (NG). The lower the fuel use, the lower the operating costs, the lower the emissions, and the "greener" the Cycle.

F. Efficiency Calculation Methodology of the VPS^{TM} Cycle

The VPS Cycle has a high thermal efficiency, a low heat rate (BTUs/kWH), and a high "Round-Trip Efficiency" (RTE). The Cycle's RTE can approach 100%. RTE is a measure of a cycle's ability to recover/release the energy stored during its inflow-to-storage period and is often viewed as the most significant metric for the effectiveness of a power storage system. For example, if a pumped hydro system has 85% efficient pumps and 90% efficient turbines, then about 77% of the energy input of that system can be recovered and released back onto the grid.

In the context of power storage systems that burn some amount of fuel (e.g., natural gas (NG)), such as Compressed Air Energy Storage (CAES) systems and the VPS Cycle (in most of its embodiments), the RTE can be calculated by subtracting the power output contribution of the NG burned from the total power output. The remainder is attributable to the initial power (e.g., wind energy) stored earlier. In that methodology, the remaining value can never be more than the total (e.g., wind) energy stored, because a system cannot "recover" more power during its outflow mode than was stored during its inflow mode. Thus, if the NG use is very low, and the RTE approaches 100%, then that cycle has a very high RTE and uses NG in a highly efficient manner. In fact, VPS uses NG far more efficiently than even the world's most advanced combined cycle gas-fired power plants.

The RTE calculations on the table below compare the NG use of the VPS Cycle to NG use in the world's most advanced combined cycle power plants, which achieve efficiencies approaching 60%. If the same amount of NG used in the VPS Cycle case illustrated in the table below were used in such a 60% efficient combined cycle power plant, then that amount of NG would be responsible for **59,804 MWH** of power annually. Subtracting that value from the **100,212 MWH** of total energy output of the VPS Cycle leaves **40,408 MWH** of annual power output that is attributable to the only other energy output source: the stored energy that was put away during the VPS Inflow-to-Storage mode. That **40,408 MWH** of output attributable to the non-NG energy input (e.g., to the wind) is approx. **95%** of the **42,288 MWH** of total annual power input (stored power) of the Inflow-to-Storage phase of VPS.

In other words, the **VPS Cycle achieves an RTE of > 95%.** Put another way, the VPS Cycle Outflow-from-Storage mode recovers nearly all of the energy stored during the Inflow-to-Storage period. After the contribution of the NG to the total power outflow is accounted for (based on its equivalent contribution in a 60% efficient combined cycle power plant), the remaining power output must be derived from the previous night's power input into the stored L-Air. That allocation can never be more than the MWH stored the night before, requiring that the calculation be "balanced" by the comparative rate (per kWH of output) at which the VPS Cycle burns NG relative to the use of the same amount of NG in a combined cycle power plant.

Another way to measure a cycle's efficiency is its "Total Conversion Efficiency"—i.e., the Total Energy Output as % of Total Energy Input (Stored Power + NG). In the example provided here, VPS has a Total Conversion Efficiency of > 70% —substantially higher than even the world's most efficient combined cycle power plants.

The VPS Cycle's very high RTE does not suggest that there are no losses during inflow or outflow, or that any portion of the Cycle is nearly 100% efficient. The RTE calculation only examines the relationship between the total power output, the amount of NG used (in the context of the power output that an equivalent amount of NG would achieve in a combined cycle power plant), and the amount of power used to produce the stored L-Air during the Inflow-to-Storage phase.

The VPS Cycle's unmatched RTE and high conversion efficiency is achieved by a deliberate "design program" inherent in the patented VPS Cycle. Because the Cycle operates across a wide range of temperatures (from 2,000° F during outflow to -230° F during inflow), there are more opportunities for energy recovery, from the heat of compression during inflow and from the refrigeration content of the L-Air during outflow.

Note: The VPS Cycle scenario presented in the table below is for an approximately 48 MW (net power outflow) power storage system, which would send out power constantly for 8 hours during the peak period, yielding about 384 MWH of output. However, the VPS system can be scaled (smaller or larger) to virtually any amount of megawatt storage required—from approx. 2 MW to 100's of MW.

Table 3: VPS Cycle Round-Trip Efficiency (RTE) Calculation Methodology

Base Case Assumptions

Storage: 225,000 gallons of L-Air = 1,368,800 pounds of L-Air = 3 tanks, 75,000 gallons each

Inflow to Storage: 10 hours per day times 5 days per week times 52.14 weeks per year

Outflow from Storage: 8 hours per day times 5 days per week times 52.14 weeks per year

Energy Flow

Inflow to Storage: 16.22 MW x 10 hours = 162.2 MWH/day; 42,288 MWH/year

Net Outflow from Storage: 48.05 MW x 8 hours = 384.4 MWH/day; 100,212 MWH/year

Natural Gas (NG) Used During Outflow: 177,005 SCF/hr; 161,959,575 BTU/hr

Heat Rate of VPS Cycle: 3,371 BTU/kWH

LHV Energy Content of NG: 915 BTU/SCF (approximate)

Power Output Content of NG Used:

MWH of power if NG is used in a highly efficient (60%) Combined-Cycle Power Plant:

59,804 MWH/year

Portion of Energy Output Attributable to Stored Energy

Total Power Output – Power Output Attributable to NG = Energy Recovered from Storage:

100,212 MWH – 59,804 MWH = 40,408 MWH

RTE = Recovered Output ÷ Inflow to Storage

40,408 ÷ 42,288 = **95.55%**

In analyzing the table above and the very high RTE achieved, it can be seen that the RTE is most sensitive to the following values:

- The amount of Inflow-to-Storage power (MWH) required to fill up the L-Air storage tank(s)
- The amount of NG used to facilitate the release of the stored power
- The amount of total power (MWH) produced during the Outflow-from-Storage phase

The high RTE and conversion efficiency of the VPS Cycle is due in part to heat recovery and cold recovery methods, some of which are described above. Those energy recovery steps are possible and worthwhile because of the wide temperature range at which the Cycle operates. The VPS Cycle can re-use large quantities (in BTUs) of low-grade (not especially hot) heat, as well as large quantities of not especially deep refrigeration. In contrast, CAES storage facilities cannot achieve such high efficiencies, because they have no refrigeration to utilize and they have few practical options to utilize their heat of compression effectively.

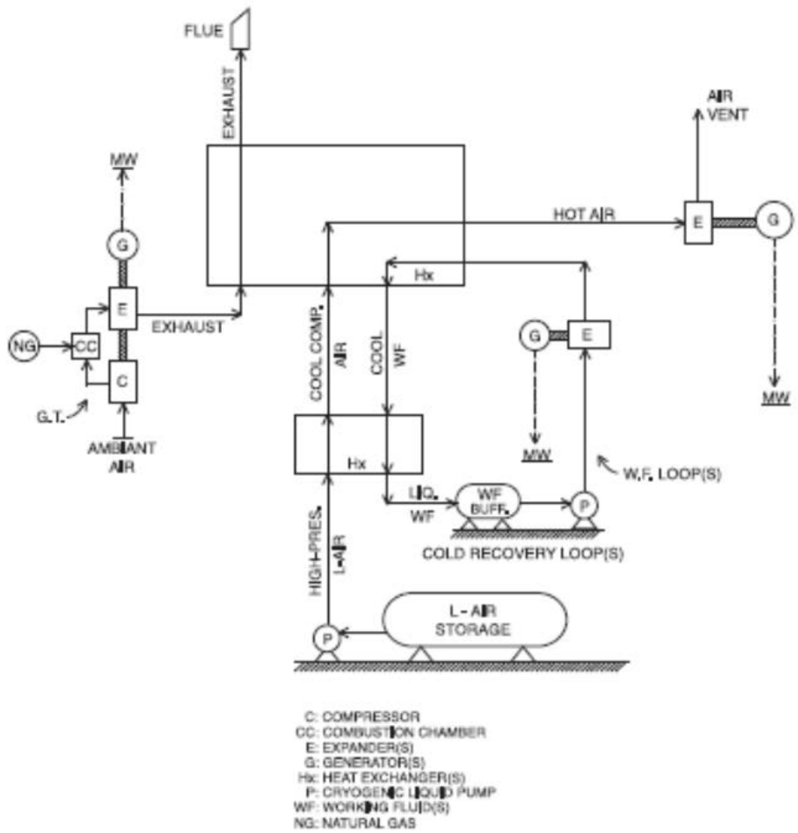
III. VPS Cycle Integration with Gas-Fired Power Plants/Peakers

In addition to "stand-alone" VPS Cycle plants, an ideal application for the VPS technology is integration with existing simple-cycle gas turbines (GTs), using the GT as the heat source for the VPS Cycle Outflow-from-Storage mode. In other words, existing simple-cycle power plants can be retrofitted with VPS technology to convert them into "daily duty" baseload power/storage assets—making them far more valuable assets than the occasionally used "peakers" that they are today, and benefiting the plant owners, ISOs, utilities and rate-payers. Hundreds of such peakers exist around the world, representing a large market opportunity.

When VPS is integrated with simple-cycle gas-fired plants, the Inflow-to-Storage phase is exactly the same as in standard VPS deployments. However, the Outflow-from-Storage phase occurs as follows during peak power demand periods. The process is also shown in Figure 3 below.

1. L-Air stored at optimal pressure and temperature is pumped to a high-pressure with cryogenic liquid pumps
2. Refrigeration content of L-Air is used to condense two counter-flowing working fluids, which in turn vaporize the outbound L-Air
3. Vaporized, high-pressure air is heated by waste heat from the GT and the hot, high-pressure air is expanded in a generator-loaded expander(s)
4. The condensed secondary working fluids are pumped to pressure, heated by GT waste heat and expanded in generator-loaded hot gas expanders
5. The former L-Air leaves the Cycle as clean air, while the secondary (closed-loop) working fluids are stored in buffer tanks after the Cycle is shut down during off-peak periods
6. Approximately **19%** of the total power output is derived from the GT and **81%** is derived from the waste heat + the energy stored in the L-Air

Figure 4: VPS Cycle Integrated with Gas-Fired Plants - Outflow-from-Storage Phase



By integrating the VPS Cycle technology, the simple-cycle GT is used in a “combined cycle” fashion, and thus becomes an ultra-high efficiency combined cycle power plant that also includes all the benefits of a power storage system. VPS allows for future power plants to be constructed in a distributed basis (rather than in very large “centralized" deployments), but matching the highest power plant thermal efficiencies now achievable in larger plants, and offering various (and many) bonus features that come from its ability to store off-peak renewable or surplus power. The only “sacrifice" is that VPS produces no power during the off-peak (nighttime) period. But most grids have surplus power during off-peak periods, so the grid will not suffer. Instead, VPS plant owners can sell and deliver power when it is most needed and valuable—at peak.

The VPS Cycle adds a new dimension to existing and future peaker plants by allowing those facilities to store low-cost off-peak power for later release during the peak power demand period. In the “greenest” model, the off-peak power (delivered at night) is “guaranteed” to come from off-peak wind, hydroelectric power, LFG-to-kW or other renewable sources, delivered by the standard electric grid (when demand is low) across some distance, and stored at the peaker/VPS site. Thus, the nighttime storage mode would be as “green” as if the peaking plant were located at the base of a wind turbine, producing no emissions during the power storage mode. The nighttime power purchase is less costly than daytime peak power, even if a premium is paid for green power.

Some of the more significant benefits of integrating the VPS Cycle with peaker plants include:

- Approx. 50% less fuel use per kWH of peak power output
- Lower overall costs per kWH of peak power output
- Lower emissions per kWH
- Provide a steady customer base for off-peak green/renewable energy
- Lower the "line losses" common in the grid transmission of electricity
- Lower the net cost of power to customers by reducing fuel costs, emissions and transmission losses
- Reduce daytime load on the grid, preventing brownouts and mitigating the need for new large power plants and extensive grid improvements

IV. VPS Cycle Integration with Air Separation Plants

One particularly "synergistic" category of VPS end-users are the hundreds of air separation plants that exist worldwide today to make industrial gases such as oxygen, nitrogen and argon. These plants tend to operate 24/7 and therefore face high "demand charges" and high peak-period energy consumption charges from electric utilities. The Inflow-to-Storage portion of VPS plants resembles portions of air separation plants that already exist. Therefore, utilizing VPS at air separation plants would require only building/deploying the Outflow-from-Storage portion of a VPS plant—substantially reducing the capital cost, complexity and footprints of such deployments. Specifically, the capital cost of VPS plants deployed at air separation plants can be reduced by approximately 33% versus stand-alone VPS plants. Thus, air separation plants are "low-hanging fruit" for VPS deployments—delivering substantial and immediate value to the customer/host, whether the VPS plant is owned by the air separation plant itself or by a third party (e.g., an IPP or an ESCO).

Because air separation plants already inherently have the ability to produce L-Air (or L-N_2 or L-O_2), the air liquefaction portion of stand-alone VPS plants does not need to be built, making even smaller-scale—2 MW or less—VPS plants economically feasible due to substantially lower capital costs.

In addition to VPS's value to air separation plants as end-users (i.e., as power consumers), VPS also represents a major opportunity for additional revenues and profits for existing air separation plants, by providing a new market for the cryogenic liquids they produce/sell. See Section VI-B below **"Additional VPS Operating Model: Truck-Delivered L-Air / L-N_2 / L-O_2."**

V. Differentiators: VPS Cycle vs. Other Liquid Air Energy Storage Systems

Several other entities have proposed liquid air energy storage (LAES) systems. However, aside from Expansion Energy, few other parties have been granted patents for their systems. This is because Expansion Energy's VPS technology contains numerous valuable innovations that make VPS substantially different from other LAES systems. This is why Expansion Energy refers to the **VPS Cycle as *advanced* LAES**. "Advanced" in this context means high efficiency/high RTE and lower capital costs and operating costs per MWH of output capacity. It also means having the ability to cost-effectively "retrofit" existing gas-fired power plants into VPS plants.

In contrast to the VPS Cycle, LAES systems proposed by other entities have the following significant disadvantages, among others:

- Low RTE of 50-60% or less (vs. > 95% for VPS), resulting in higher operating costs and wasted energy
- Rudimentary cold recovery systems; under-utilized "cold energy"
- The need to produce several times more L-Air volume vs. VPS for the same amount of MWH output
- Higher capital cost per MWH of output

VI. "Commercial-Scale VPS" – 2 MW to 20 MW

In addition to the "Utility-Scale" (20 MW to 100's of MW) version of the VPS Cycle, Expansion Energy has developed a smaller, simplified and lower-cost "Commercial-Scale" version of the VPS Cycle—2 MW to 20 MW—which are pre-designed and 100% factory-manufactured, then delivered to the deployment site on skids, eliminating the need for on-site construction. This approach greatly increases the deployment potential (and market size) for VPS plants. Commercial-Scale VPS plants are deployable at virtually any location that consumes at least 2 MW of power and has a natural gas grid connection. As such, Commercial-Scale VPS represents a potential "paradigm shift" in how energy is produced, delivered, stored and used worldwide.

Key elements of Commercial-Scale VPS include:

- A factory-built, modular "appliance" version of the VPS Cycle
- Enables **distributed generation + distributed power storage**
- Serves a scale too small for CAES or pumped hydro and too large for batteries—2 MW to 20 MW
- Delivered on several skids that are connected at the deployment site – constructed in days/weeks
- Pre-designed/pre-engineered + mass-produced
- Market potential = Thousands of deployments
- Provides both a daily duty cycle (delivery of power during peak period) + reliability/back-up power
- Surplus power (beyond the needs of the owner) can be sold to the grid for profit

Like Utility-Scale VPS, Commercial-Scale VPS is designed to operate on a daily cycle, storing energy during the overnight off-peak period and **releasing 8-12 hours of power per day (at a constant release rate)** during the grid's peak demand period—making VPS a "baseload" power storage solution. Commercial-Scale VPS preserves many other important advantages that Utility-Scale VPS delivers, such as:

- Components are 100% commercially available ("off-the-shelf")
- "Round-trip efficiency" (RTE) > 90%
- Low capital cost per kWh (of daily storage & release capacity): $165-$275/kWh
- Can be deployed virtually anywhere above-ground
- Substantially reduces grid congestion if sited near high-demand end-users/load centers
- Ultra-high BTU conversion efficiency—Heat Rate = ~ 4,000 BTU/kWH (vs. 6,660-7,700/kWH for combined cycle plants)
- Fast start – less than 20 minutes to reach full outflow capacity (+ partial outflow faster)
- 10 X greater storage density than compressed air energy storage (CAES) + much higher RTE than CAES
- 100% man-made (no reliance on special geologic conditions/caverns)—reliable, predictable, replicable
- Expected useful life of 40+ years

Despite the many similarities, there are certain key differences between the larger Utility-Scale VPS and the smaller, modular Commercial-Scale VPS systems, which are summarized in the table below.

Table 4: Utility-Scale VPS vs. Commercial-Scale VPS – Key Differences

	Utility-Scale VPS	Commercial-Scale VPS
Scales	20 MW to 100's of MW	2 MW to 20 MW
Construction	Field-erected (site-constructed, like a power plant)	Factory-built (a modular, manufactured "appliance")
Design / Engineering	Custom design/engineering (new design for each VPS plant)	Standardized design/engineering (each design pays "dividends" across dozens/hundreds of units)
Application	Centralized/substation energy storage	Distributed energy storage + End-user reduction of peak demand and power consumption; back-up/reliability
Customers	• Utilities & Power Cooperatives • Power Generators	• Utilities & Power Cooperatives • Power Generators • Industrial Power Users • Commercial Power Users • Microgrids & Military
Competing Technologies	Pumped Hydro + CAES (each require scales > 100 MW)	Virtually no competition (2-20 MW is too large for Batteries and too small for Pumped Hydro + CAES)
Market Potential (# of plants)	Dozens or hundreds	Thousands
CAPEX per Plant	~ $75 million for 45 MW VPS plant	~ $4 million for 2 MW VPS plant ~ $20 million for 10 MW VPS plant
CAPEX/kWh of Daily Capacity	$125-$250/kWh	$165-$275/kWh

A. Customers/End-Users

Whereas the target customers for Utility-Scale VPS plants are necessarily limited primarily to utilities, power cooperatives and power generators, the market for Commercial-Scale (2-20 MW) VPS plants includes the following, among others:

- Industrial facilities / factories / refineries
- Utility – T&D "tight spots" / capacity upgrades
- Military bases
- Hospitals
- Office parks / corporate campuses
- Shopping centers
- Airports & shipping ports
- Microgrids
- Wind farms & solar farms
- University campuses
- Data centers / server farms
- Food processing / refrigerated warehouses
- Mines & quarries
- Other critical buildings / infrastructure

B. Additional VPS Operating Model: Truck-Delivered L-Air / L-N_2 / L-O_2

The smaller scale of Commercial-Scale VPS plants make it economically feasible to deploy simpler, lower-cost versions of the VPS Cycle—specifically by eliminating the need for producing L-Air on-site in the Inflow-to-Storage phase of the Cycle. Rather than producing L-Air on-site, L-Air, liquefied nitrogen (L-N_2) or liquefied oxygen (L-O_2) can be trucked to the VPS site, where such delivered L-Air, L-N_2 or L-O_2 is utilized by VPS's Outflow-from-Storage phase in exactly the same way as if it had been produced on-site.

L-N_2 or L-O_2 or L-Air is produced by the hundreds of air separation plants that exist around the world, owned and operated by companies that produce/sell industrial gases. These companies routinely and safely deliver L-N_2, L-O_2 and other cryogenic liquids by tanker trucks/trailers. As such, VPS plants utilizing any of these truck-delivered cryogenic fluids represent a major new market opportunity for existing air separation facilities. In fact, many air separation plants have a surplus of either L-N_2 or L-O_2 (because their key customers need only one of those products). VPS can utilize such surplus products (either L-N_2 or L-O_2), providing an additional revenue stream for existing air separation plants, resulting in greater profitability and resource efficiency. If desired, air separation plants can also be designed to simply produce L-Air for VPS plants (rather than the "separated" elemental gases—L-N_2 or L-O_2, etc.).

Eliminating the on-site Inflow-to-Storage phase of a VPS plant reduces the capital cost for such VPS deployment by approx. 33%. This allows more VPS plants to be deployed with less capital. It also makes deployment of even smaller-scale VPS plants cost-effective. **Under this operating model, VPS Cycle plants at scales of 2 MW or less are economically feasible.**

Utilizing truck-delivered cryogenic fluids also provides an additional degree of reliability for VPS plant owners, as the L-Air, L-N_2 or L-O_2 can be sourced from any number of nearby air separation plants.

C. Additional Benefit of Commercial-Scale VPS: Back-up Power & Resiliency

If access to grid power is interrupted for any reason, the prime mover (e.g., gas turbine or natural gas engine) of Commercial-Scale VPS plants can continue to generate power (1 MW to 4 MW, depending on the scale of that particular VPS plant) for an extended period (hours/days/weeks/months) even if no new L-Air is produced by the "front end" Inflow-to-Storage portion of the VPS plant. As long as the VPS plant's connection to the natural gas pipeline system is intact, each VPS plant will continue to have 10% to 20% of its rated power outflow capacity available as back-up generation.

As described in the previous section, if truck-delivered L-Air, L-N2 or L-O2 can be delivered to the VPS plant (as opposed to making L-Air, L-N2 or L-O2 on-site), then the VPS plant can operate at 100% of its rated power output 24/7 for an indefinite period of time, providing even more back-up power and resiliency benefits.

For facilities that normally require emergency back-up generators (e.g., hospitals, public buildings, server farms, military facilities, etc.), Commercial-Scale VPS can eliminate the need for that equipment, because the VPS Cycle can produce power even if the grid is down, as long as the natural gas system is functioning. The elimination of standard back-up generators will reduce the capital and operating costs of redundant equipment, and eliminate the need for diesel fuel storage tanks for back-up generators.

D. Economics / ROI of Commercial-Scale VPS Plants

Information from independent energy policy organizations such as the New York State Energy Research & Development Authority (NYSERDA) suggest that the 25-year **Present Value (PV)** of energy storage assets that reduce an industrial customer's peak demand charges and peak power consumption charges **may exceed $5,000/kW**—far higher than the capital cost of VPS plants deployed at air separation plants (~ $1,300/kW) or at other types of industrial facilities (~ $1,600-$2,000/kW). Thus, the return-on-investment—i.e., the Net Present Value—potential for Commercial-Scale VPS plants at many industrial facilities is extraordinarily high. There is also a high ROI pattern for utility owners of Commercial-Scale VPS plants in regions where power storage is in demand—either because of market need or government/regulatory policy.

E. Large, Fast-Growing Market

Because Commercial-Scale VPS plants can be deployed for so many applications, **VPS represents a multi-billion-dollar revenue opportunity for VPS technology licensees**. Hundreds of pre-engineered, factory-built, skid-mounted Commercial-Scale VPS units could be deployed annually worldwide, with each VPS unit providing all or a portion of its power output to the host site, and with the "surplus" portion (if any) sold to the grid.

VII. How "Green" Is the Power Output of the VPS^{TM} Cycle?

A. Efficiency & "Green" Content

There are several methods for calculating renewable power's (e.g., wind) contribution to the peak period power output delivered via the VPS Cycle. One method compares the total power output to its two energy input sources: wind and natural gas. By that method, as illustrated in the example in Section II-F (~ 48 MW of power outflow), the wind contributes 42,288 MWH of energy annually, while the natural gas needed to release the stored energy contributes 99,674 MWH of energy annually. Thus, the wind's contribution to the total energy input of 141,962 MWH can be calculated as approximately 30%. However, looking at the total recovered annual energy output of 100,212 MWH, of which 42,288 MWH are attributable to the wind, we can say that the wind component is approximately 42% of the total power output. Thus, depending on how the calculation is done, the Cycle is between 30% and 42% "green" when it stores wind or other renewable energy.

It should be noted that the total recovered power output is approximately 70% of the total energy input, which is significantly more efficient than even the most efficient large-scale combined cycle power plants (which are about 60% efficient), confirming the superiority of the VPS Cycle and especially its innovative heat- and cold-recovery systems. Importantly, that 70% efficiency is not the Cycle's Round-Trip Efficiency (RTE) because it is not a measure of how much of the inflow (wind-derived) energy is recovered by the Cycle.

Siting the VPS Cycle at landfill gas (LFG) or anaerobic digester gas (ADG) power plants would result in a "100% green" system because those fuel sources are themselves renewable. In those deployments, a portion of the LFG or ADG is used as VPS's heat source during the Outflow-from-Storage phase, while 100% of the LFG or ADG is used for power production during the Inflow-to-Storage phase. At sites where the LFG or ADG is used as the fuel to generate power in a turbine, the VPS Cycle allows the power produced in the 24-hour cycle to be reserved for sale during the highest value (e.g., 8) peak hours, thus substantially increasing the revenues derived from power sales. The combination of the VPS Cycle and LFG/ADG as fuel yields a highly efficient and "100% green" system, delivering its power output during only the highest value periods.

Other integrations with green energy include the deployment of VPS with geothermal power/heat sources. The geothermal heat source does not necessarily need to be the high-grade heat that VPS prefers, because any shortfall in the grade of heat (i.e., its temperature) can be made up by using natural gas as a supplemental fuel/heat source.

B. CO_2 Emissions Reduction

Another method for evaluating the "green" aspects of the VPS Cycle is the amount of CO_2 it emits per MWH of peak power output. The typical gas-fired combined cycle power plant emits 0.370 tons of CO_2 per MWH of power output. In contrast, the VPS Cycle (in the deployment scenario described in Section II-F (~ 48 MW of power outflow)) emits an estimated 0.211 tons of CO_2 per MWH of power output—or approximately 57% of a typical combined cycle power plant. Thus, the VPS Cycle deployment described above avoids about 16,000 tons of CO_2 emissions annually (when compared to high-efficiency combined cycle plants), mostly as a result of the stored wind energy, but also because VPS utilizes NG more efficiently and makes good use of recovered heat and cold.

When compared to a standard 37% efficient simple-cycle gas-fired power plant (instead of a combined cycle plant), VPS's emissions reduction advantages are even more pronounced. If measured on 24-hour basis (because standard power plants cannot be effectively turned down during the night), VPS reduces CO_2 emissions by about two-thirds compared with standard simple-cycle gas plants.

C. Reduced Water Consumption / Water Production

The use of water (a scarce resource in many regions) for cooling power plants has emerged as a major environmental issue. Power plant cooling is currently one of the largest consumers of water globally.

Unlike most other types of power plants, the VPS Cycle does not "use" water. In fact, a 100 MW VPS plant actually *produces* about 70,000 gallons/day of water as a byproduct—from exhaust of the prime mover, which condenses in the flue gas. Therefore, VPS plants have a very low environmental impact in terms of water consumption, making VPS an even "greener" solution.

D. Seasonal Optimizations

Other operational and design optimizations of the VPS Cycle can achieve even higher degrees of "greenness" than outlined above, while maintaining 100% reliability. For example, winter (cold weather) operations will reduce the power needed to compress the inlet air to the L-Air production system in the Inflow-to-Storage phase (because colder air is denser); but hot weather operations will not increase the compression required because of the use of an absorption chiller to pre-cool the inlet air to the compressor.

During the off-peak Inflow-to-Storage period, the nighttime air may be 0° F or lower, containing very little moisture, and being significantly denser than the, e.g., 80° F inlet air temperature on a summer night. The power required to compress such cold inlet air will be significantly less than required to compress 80° F air. That benefit allows the equipment to operate at the same power input rate but with a higher air intake, yielding more stored L-Air during the same hours of Inflow-to-Storage, or allowing for the same amount of stored L-Air to be produced in fewer hours.

VIII. Economics

The economics of any type of energy storage deployment can vary greatly depending on scale, the type of storage benefits provided, peak versus off-peak power values, proximity to the load, deployment region, and regulatory and legislative incentives/mandates, among numerous other factors. Nonetheless, deployment scenarios examined thus far for the VPS Cycle generally show quite attractive economics and overall value to the electrical grid and power consumers.

For example, Expansion Energy recently completed a feasibility study with the New York City utility, Con Edison, which was sponsored by the New York State Energy Research & Development Authority (NYSERDA). The study found that a **~ $98 million VPS plant** (total turnkey cost) **would yield a total Net Present Value of $218 million** to the electrical system—and such value could be split between Con Edison (as a return on its VPS investment) and the ratepayers. This high ROI was due in large part to the fact that VPS can be sited close to the load—which brings many more benefits to the electrical system than storage projects sited far from the load (where nearly all CAES and Pumped Hydro projects would necessarily reside).

Expansion Energy has also analyzed the economics for Commercial-Scale VPS deployments using the same methodology and assumptions utilized for the NYSERDA feasibility study referenced in the previous paragraph. Results show that **Commercial-Scale VPS plants generally deliver Net Present Values (NPV) of 2-3 X their turnkey capital cost**—an extraordinarily high return-on-investment.

IX. Conclusions

The market opportunity for both Utility-Scale and Commercial-Scale VPS Cycle plants is massive. VPS represents a potential "paradigm shift" in how energy is produced, delivered, stored and used. The need for Utility-Scale power storage assets such as the VPS Cycle to serve grid-level needs is well-documented. VPS provides much greater efficiency, replicability and siting flexibility than other bulk energy storage technology, such as compressed air energy storage (CAES) and pumped hydro.

Additionally, worldwide, virtually every facility that uses more than 2 MW of power from the electric grid and is served by a natural gas grid connection is a candidate site for a Commercial-Scale VPS plant—which delivers benefits to the grid and "behind-the-meter." Commercial-Scale VPS plants are smaller, simpler and lower-cost than Utility-Scale versions of VPS. Commercial-Scale VPS addresses an even broader and larger market than Utility-Scale deployments. **These modular, standardized, factory-built "appliances" serve the large market for power storage at 2 MW to 20 MW—scales where today there is virtually no other cost-effective technological solution for bulk energy storage**, as these scales are generally too small for CAES and pumped hydro and too large for multi-hour battery storage.

Each VPS Cycle deployment could eventually become part of a widespread network of cost-effective, low-emissions distributed storage and distributed generation assets—**combining the well-recognized economic and operational benefits of power storage *and* distributed generation**—two of the most important trends in the power industry today.

X. Targeted Licensees of the VPS Technology

Expansion Energy is actively seeking licensees for the VPS Cycle technology. We invite qualified parties to contact us to discuss licensing and deployment possibilities.

- **Manufacturers/vendors of energy equipment** serving the markets for power generation, power storage or power distribution may be interested in licensing the VPS Cycle technology as addition to their product portfolios—either Commercial-Scale VPS (factory-built) or Utility-Scale VPS (field-erected).

- **Engineering, procurement and construction (EPC)** companies involved in designing, building and/or operating power-related assets may wish to license the VPS technology to expand their offerings to clients.

- **Independent power producers (IPPs) and utilities** may wish to license the VPS technology to include VPS plants as part of their asset portfolios.

- **Large industrial/commercial power consumers** may wish to license the VPS technology to own/operate "behind-the-meter" VPS plants that can reduce their operating costs, and increase profits and reliability.

Contact Information

Qualified parties interested in discussing the VPS Cycle technology are invited to contact Expansion Energy for further information by visiting the "Contact Us" page of our website (www.expansion-energy.com) or by emailing us at **info@expansion-energy.com**.