



BEDROCK ENERGY CORP.  
100 Arisaig Drive  
Vaughan, Ontario, Canada  
L6A 1V7

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## **Bedrock Energy Corp. Response to the Ministry of Natural Resources & Forestry Draft Compressed Air Energy Storage in Porous Rock Reservoir Regulation Posting**

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Bedrock Energy Corp. (“Bedrock”) is appreciative of the opportunity to offer commentary on the Ontario Ministry of Natural Resources and Forestry’s (“MNR”) draft Compressed Air Energy Storage (“CAES”) in porous rock reservoir Regulation (“O.Reg”) and wishes to equally recognize the significant work and effort that the MNR staff has undertaken in drafting this.

Bedrock is supportive of the overall CAES porous rock reservoir regulatory framework, which the draft O.Reg embodies. Yes, there are some practical suggestions for commercial implementation and development improvements, but Bedrock would observe that the MNR’s parallel trajectory for CAES, aligned with many of the historic principles set out for natural gas storage regulatory and development approvals, serves as a well proven roadmap for the advent of grid-scale CAES. This is especially true and reliable, given the eight decades of expert engineering experience that Ontario already has with natural gas storage developments, reservoir pressurization and safe operations.

Bedrock’s observations and recommendations follow the order in which the MNR has offered its framework items for public response in its PROPOSED CHANGES TO ONTARIO REGULATION 245/97 UNDER THE OIL, GAS AND SALT RESOURCES ACT, issued in January 2021.

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### **Why is the Ontario Government proposing these changes related to compressed air energy storage projects? Are there more opportunities coming for these types of energy storage projects in the future?** (page 2 of 15)

Bedrock is supportive and appreciative that the Ontario Government is committed to providing clear regulatory and business environments. The introduction of this draft O.Reg for CAES in porous rock reservoirs is an important first step to achieve several strategic objectives in Ontario’s energy industry to the direct benefit of electricity ratepayers. The appropriate repurposing of these valuable, 450 million year-old pinnacle reservoirs, formerly used for natural gas production, and now to redeploy as CAES vessels, allows for:

- Storing wasted nuclear, solar and wind power, for later usage when it is needed
- Lowering electricity costs each time the stored power is released into the market
- Saving millions in Surplus Baseload Generation (“SBG”) power costs annually, billions over a project lifecycle
- Utilizing intra-provincial assets and resources in an environmentally responsible manner
- On-farm reliable annual income for farmer/landowners
- Providing much-needed operating flexibility for the Ontario Independent Electricity System Operator (“IESO”) -controlled grid
- Significant employment during construction and ongoing jobs during operations
- Private capital investment to meet grid-system needs in the latter half of this decade and beyond
- Infrastructure investments of millions of dollars without government subsidies

The above reasons should amply justify the introduction and growth of Ontario’s energy storage industry; CAES is one of the means by which to achieve, in a cost-competitive manner, the objectives of providing the IESO with a critical tool in its grid management toolbox. Since the coal-powered fleet was removed from service, the IESO has had to work very hard to manage the flexibility lost from coal to the grid. CAES would go a long way to alleviate this system stress.

The draft O.Reg refers to one perspective that:

*“Ontario’s electricity needs can largely be met with existing and available resources. Neither the Ontario government nor the Independent Electricity System Operator has any specific plans or programs targeting additional energy storage at this time.”*

Bedrock largely agrees with the accuracy of this statement up until 2026, but after that time, there will be a very clear need for additional electricity supply and balancing resources, including electricity storage, according to the IESO’s forecasts. There is a recognition that energy storage can play a significant and important economic role according to the IESO’s September 2020 **Energy Storage Design Project Long-Term Design Vision**<sup>1</sup> document and the Energy Storage Canada (“ESC”) Economic Valuation Report<sup>2</sup>. Additional support for energy storage in Ontario can be found in the Navigant study commissioned by TC Energy<sup>3</sup>.

Bedrock predicts that Ontario will become a world leader in energy storage development; CAES in porous rock formations will be one of the key means to making the Hydro One Networks Inc. (“HONI”) grid more flexible and efficient over the balance of this decade, and beyond. Bedrock welcomes competitive procurement processes, but openly notes that some form of certainty of off-take will be required to ensure adequate project support.

## **PROPOSED CHANGES FOR ALL COMPRESSED AIR ENERGY STORAGE PROJECTS IN POROUS ROCK RESERVOIRS**

MNRF references myriad changes that will need to be made subject to the *Oil, Gas and Salt Resources Act* (“OGSRA”). These include:

- Technical
- Financial
- Security
- Insurance coverage
- Notification/engagement
- Administrative requirements
- Compliance
- Decommissioning
- Other more detailed requirements

Bedrock agrees that the safest and most reliable CAES projects will be those that are located within the geologically suitable boundaries set out in Figure 1 (page 4 of 15) if they are restricted to Silurian Pinnacle Reefs, which are the most well-known and proven porous rock structures to be converted to pressurized air containers, according to industry-accepted delta-pressurization protocols. Other geological container structures may well be

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<sup>1</sup> <https://www.ieso.ca/en/sector-participants/engagement-initiatives/engagements/energy-storage-advisory-group>

<sup>2</sup> <https://static1.squarespace.com/static/54485dc4e4b0f7bd2239a06b/t/5f11ca45f37fcb7b7e77584a/1595001417141/nlocking+Potential+-+An+Economic+Valuation+of+Energy+Storage+in+Ontario+%28July+2020%29.pdf>

<sup>3</sup> <https://www.tcenergy.com/siteassets/pdfs/power/pumped-storage-project/tc-energy-value-of-pumped-storage-project-report.pdf>

suitable for CAES, and these should be allowed if they meet specified criteria, eventually to be established by the MNRF.

That said, Bedrock agrees with the MNRF that the three conditions to be met presently for a CAES approval under the OGSRA should be:

- (a) CAES in porous rock formations must only be developed in pinnacle structures. The description of the pinnacle structure referenced in *note 1* needs to be modified to be within the Silurian A-1/Guelph/Lockport Group of geological formations;
- (b) Located within the boundary area referred to above; and
- (c) A geological formation which has been operated for gas production or gas storage

Meeting *all* of these criteria allows for a de-risked, predictable and reliable development of on-shore rock formations according to a great deal of acquired gas storage and geological knowledge over a hundred years, with evolving technology and lessons learned. Ontarians will benefit from developments that smartly use this existing knowledge and previously deployed scientific techniques in these time-tested pinnacle formation types, which this O.Reg appears to have captured and for which it proposes reasonable restrictions at this time.

## SCOPE OF REGULATORY CONTROLS

Bedrock supports the MRNF's approach to replicating as much of the OGSRA framework used in deploying CAES in salt formations, as much as possible and practicable in CAES porous rock formations. The list of items noted by the MNRF sensibly includes:

- Emergency shut-down valves
- All pipelines
- Associated equipment
- Drilling
- Completions
- Maintenance
- Well and surface equipment servicing and protocols
- Overhauling
- Working over
- Abandonment or decommissioning

Many of the practices to be applied to these CAES developments originate in the lengthy evolution and tenure of the Ontario Oil and Gas ("O&G") industry. CAES should be well served by the practical application of many of the pertinent and relevant rules, requirements, protocols, and industry compliance obligations, subject to adjustments, where justified and appropriate. Bedrock's CAES projects are understandably prepared to be subject to municipal approvals, environmental compliance approvals under the Environmental Protection Act and regulations under the Technical Standards and Safety Act, as appropriate.

We also assume that an applicant will need to meet the requirements of the Ontario Heritage Act, take in-situ soil samples to ensure compliance under O.Reg 406/19, conduct natural heritage surveys pursuant to the Endangered Species Act, and obtain local Conservation Authority Permits under O.Reg 97/04.

Bedrock would appreciate the MNRF clarifying, in whatever form it sees fit, certain aspect of its expectations to an applicant, such as how the MNRF would judge whether a proposed neighbouring feature or activity is likely to be implemented or affected, guidelines as to how the MNRF would judge that an applicant/proponent has done a sufficient job of defining 'neighbouring'. Would this be by a spatial boundary or other parameter?

Other matters for the MNRF to consider is whether it wishes an applicant to identify impacts as well as mitigation and monitoring, and if so, to what extent. One possible suggestion to consider is the Ontario Energy Board's Environmental Guidelines for the Location, Construction and Operation of Hydrocarbon Pipelines and Facilities in Ontario (2016), which may provide sufficient standards, processes and guidance.

Bedrock's environmental advisor would appreciate understanding how the MNRF would judge that a residual risk has been sufficiently mitigated to a level that is as low as is reasonably practicable. Similarly, advance advice from the MNRF as to how the ministry would judge that, and to what extent has a satisfactory risk assessment has been completed would be helpful to applicants and their advisors.

## **PROPOSED REQUIREMENTS FOR CAES USING PINNACLE STRUCTURES**

Bedrock agrees with the MNRF that each well in a CAES project will require a well licence, and an injection permit. The 'Note' below this heading reiterates that CAES projects may only occur in pinnacle structures that have heretofore been used for O&G production activities. Bedrock understands and agrees that it is to be expected that prior O&G operations and their decommissioning should be subject to the existing framework for geological activities; equally, new CAES evaluation wells would also be subject to this downhole engineering and geological framework.

While to date, the only two commercial-scale CAES projects, located in Alabama and Germany, are using salt formations for the air containers, there are others planned in Europe and Texas as energy storage becomes highly necessary and set to become mainstream technology. Current basic above-ground CAES technology is neither novel or complex; it is a reconfiguration of existing equipment. CAES involves large-scale air compressors, turbines and generators – all of which exist and can be acquired relatively 'off-the-shelf' from a few manufacturers, such as Dresser Rand, Siemens, Mitsubishi, and General Electric, to name a few. Equipment of this type has been around for decades and is consistently in a state of engineering evolution and improvements for efficiency and scale.

The limited unique feature that CAES has not yet demonstrated *commercially* is to harvest as much heat as possible emanating from the compression cycle(s), then store that heat in a reusable medium, then possibly redeploying the heat on the withdrawal cycle to increase efficiency, to supplement the optimal heat required by the turbines driving the generators on the withdrawal cycle - assuming the economics thereof are positive. If it is not practical or economic to re-use the compression heat in the generation cycle, then some other solution will be explored for heat conservation and re-use. Much engineering work has been undertaken on this technology by manufacturers such as Siemens for its Bethel Texas project (watch video here: [https://youtu.be/d\\_-MPHDq2Y8](https://youtu.be/d_-MPHDq2Y8)). Bedrock has made significant engineering progress on this heat management to ensure its CAES projects are state-of-the-art in terms of energy efficiency. All of this technology development is welcome in the CAES process, and Ontario can be proud to be a leader in that field.

The only real differences between building CAES in salt formations versus porous rock lies in (a) purging residual gas out of the porous rock (there is none in salt formations), and (b) drilling multiple wells into the rock (few wells needed for CAES in salt formations). There is significant Ontario experience in using porous rock for pressurized storage of natural gas – far more than using salt formations.

What is also true is that there are many applicable technical standards already in place, which will and should be relatively easily applicable to CAES in porous rock developments. These include transferring knowledge from gas storage operations to establish consistent parameters for the design, operation and decommissioning of CAES projects. Many of these standards are already codified in the CSA Z341: *Storage of Hydrocarbons in Underground Formations* standards, so MNRF permitting of CAES in rock formations is not inventing a 'new wheel'.

Bedrock fully agrees that important technical issues will be addressed by highly qualified engineers. These will include scrutiny in planning and programs that address casing type, wall thickness, anti-corrosion management, to name just a few, amongst a host of other practical matters. The list [Parts 3,4,5,6,8,11,12 and 13] that MNRF provides on page 6 of 15 represents a comprehensive approach to organize and peer review a CAES project that features protection of the public and environmental safety. Reviewed independently by other qualified and specialized engineers in a proper, timely and reasonable peer review process, is expected and welcomed. There are several engineering firms that specialize in this type of geological formation, which can assist CAES proponents and provide independent peer review of proposals for the MNRF.

Bedrock would like to emphasize that this type of thorough review is welcome in the context that the financing parties to this type of project will be conducting their own due diligence reviews prior to financing and any commencement of construction. This type of timely, transparent project review by independent (primarily engineering) professionals will bolster the project and confirm its commercial legitimacy.

### **Existing Requirements within Ontario Regulation 245/97**

Bedrock has reviewed MNRF's proposed requirements arising from this O.Reg. and will offer its comments in the order they appear on pages 6 and 7 of 15.

Section 1 Definitions understandable and acceptable.

Sections 3 and 4 dealing with well licences and drilling wells. It is proposed that due to the higher volume of well bores to be drilled concurrently and immediately consecutively, there will need to be suitable amendments to the normal one year licence expiry and termination permitting (even if this require other legislative amendments), such that the range of well drilling dates can be arranged based on a broader target timeframe, specified as a condition or extension of the licence (example given: a date on which the licence holder is authorized to commence drilling and expected duration of the entire drilling program). Bedrock believes this is a good start to accommodate the practical necessities of a multi-well drilling program, which may, for example, take approximately a year or two to complete the full set of wells in a Designated Storage Area ("DSA").

By way of practical example, Bedrock respectfully (even strongly) recommends consideration of an amended 'blanket' well planning and drilling licence protocol, applicable to and coincident with an applicant's overall CAES development program. This type of flexible, practical and realistic incremental approach will allow for the CAES well drillers to optimize the knowledge gained with each well drilled, and to improve the prospects of finding and reaching the best porosity of the reservoir. Please consider the following example of how this can work:

- CAES engineers plan 30 vertical wells to penetrate the pinnacle formations.
- Each well requires an MNRF licence with a specific well licence # assigned to it.
- All the vertical (and horizontal) licenced wells will be individually designed, laid out, and submitted in a new consolidated CAES project-based, preliminary proposed licence registration process to the MNRF.
- The CAES project will include all wells listed to be drilled within a proposed DSA.
- MNRF would receive, recognize, examine and review the developer's overall proposed well plan.
- MNRF provides the developer with a conditional blanket wells approval certificate, taking into account the developer's DSA master well drilling plan. No other party is allowed into the DSA, which protects that formation resource.
- The MNRF's approval will certify that the CAES developer will be provided a proposed rig-in start date to commence the full drilling phase of the project, when the developer notifies it is ready to proceed, similar to a renewable energy project's *Notice to Proceed* ("NTP").

- Bedrock envisages that as an early part of the well field preparation process, it may ask the MNRF to issue two well licences specifically for each reservoir (one injection and one withdrawal), in order that it can sweep residual hydrocarbons prior to commencing the full well drilling program.
- Once the sweep is completed, as each well is drilled, and its precise location, depth, and all other normal details are recorded, once per month, an information report/transfer will be made to the MNRF certifying the records of the well(s) drilled and these wells will be registered accordingly. This allows for the smart ongoing search for the more porous areas of the formation.
- As new geological data is collected from wells as they are drilled, the developer may need to slightly adjust the trajectory of wells still to be drilled. Prior to drilling these additional wells, the developer would inform the MNRF of the proposed changes in trajectories.
- Once all the wells are drilled and records have been submitted and approved, then MNRF will sign-off on the completion of the well drilling program, and the normal operations and maintenance of all the wells in the new DSA will be certified as ready for injection and withdrawal operations and for commissioning of the CAES facility and the permanent operation.
- As the facility will be expected to be in operation for 50+ years, these will be long-term approvals, with maintenance and Examiner reporting to the MNRF on some sufficiently frequent, reasonable basis.

The critical point here is that there must be some overarching consolidation approval of the anticipated wells to be drilled - then they are drilled within the DSA over an estimated, limited, but flexible time horizon. The new CAES well licence application program must be pre-approved by the MNRF, without undue micro-management by the MNRF on a daily well-by-well basis, except that when each of the wells is drilled and completed, full records of all the specific field work and results must be submitted in the normal course to the MNRF.

There cannot practically be well drilling ‘starts and stops’ in a one-off manner as this could turn into a regulatory risk challenge; the solution has to be organized as a set of well licences that make up an entire DSA drilling program, approved and permitted as a ‘CAES well field’, consolidated and built on well pads, to minimize environmental damage during construction and during well servicing. Without this type of consolidated well drilling program approval within a flexible time/term, it may be unlikely that the CAES project will be financeable as individual well drilling programs and the development regulatory risks will be too high.

Bedrock also would emphasize that from a strictly business perspective, all well licences would have to be issued with a projected operating life that would coincide, at a minimum, with the financing and expected life of the full CAES project, otherwise the amortization of the project financing may not fit the critical financing terms. This is a very important point in the permitting process.

Annual Well Licencing Fees of \$250 are fine.

Section 7 registration of works are fine.

Spacing and unitization provisions, where applicable, are understandable and acceptable to appreciate potential for interference.

The application of Sections 17 (Well Control and Blowout Prevention), 19 (Plugging Dry or Unused Wells), 20.1 (Release of Information) and 22 (Work Tags) may be reasonably applied when and where applicable.

Bedrock is in full agreement with MNRF that these pinnacle structures are effectively valuable provincial resources, which require protection for CAES installations, directly analogous to the DSA protections that are applicable to gas storage areas.

Bedrock agrees with the normal Section 23 requirements for Examiners to report to the MNRF with certain modifications for a new class of Examiner being a qualified and currently certified Professional Engineer.

The *Note* provided by the MNRF on page 7 of 15 references the provisions of the OGSRA involving tribunals for referrals and appeals that would apply to these applications and operations, in the same way they currently apply to other activities regulated under the Act. Bedrock supports the continuation of these referral and appeal tribunals as there is good reasons of practical experience and administrative efficiency to continue their applicability.

### *Key Recommendation*

The one missing piece to this otherwise comprehensive regulatory fabric, which could thwart this type of CAES development, is the need for ‘pooling’ in the event a landowner refuses to participate. The MNRF is familiar with the processes involved in developing gas storage, and aware of the mechanisms in place for gas storage reservoirs to be developed, notwithstanding there may be a ‘hold-out’ landowner. If a reservoir development is independently approved, there is usually community support, and a strong public interest component in the project, i.e. that activities and resources will be used in a natural gas or utility market to benefit ratepayers and competitive market participants. The legislature has seen fit to provide the Ontario Energy Board (“OEB”) with the statutory powers to address this type of impasse situation - not only in the case of gas storage, but also in respect of utility wires and pipelines, and even where private, non-utility developments (eg. CanEnerco Gas Storage) were temporarily stopped, via an appeal/petition, by a hold-out landowner.

Bedrock respectfully urges that the final CAES O.Reg must allow for appeals or reviews by either landowners or development companies, who should be able to take a disputed land matter to the OEB or the new Lands Tribunal, in the case of an impasse on either compensation or rights to use and access lands and the subsurface pinnacle formation, especially when a majority of the landowners are supportive of the development.

Finally, from our Zoom meeting with the MNRF staff, if this particular remedy to include resistant landowners requires a legislative amendment to the OGSRA, then respectfully, that necessary amendment should be included in the MNRF’s findings and recommendations, such that the next time the OGSRA is amended as it is from time to time, this appeal provision to a tribunal would be included in that act, and any other act where an ancillary amendment provision is needed.

### **Proposed Application Requirements**

Bedrock is supportive of the MNRF’s proposal to submit all the well and conversion licence and injection permit applications at the same time, and not in some piece-meal manner. While it is good that there is the choice of a pilot process (which will require resubmission for a full development), it is equally suitable that full development applications are allowed from the outset.

Bedrock is fine with the *Application Fees* and the digital *Submission Format*.

In respect of the *General Project Information*, Bedrock is fully supportive of the MNRF’s approach to providing, at a minimum, the four listed heads (and details) of information expected to be filed with the CAES Application.

Bedrock’s principals are familiar with insurance studies and related issues in developing non-utility gas storage here in Ontario. Having worked closely in previous nearby gas storage projects with landowners to ensure their development and operational expectations are met in terms of adequate insurance, Bedrock’s owners have this type of experience. It is entirely appropriate to be engaging an independent, expert insurance team, who will be conducting a comprehensive insurance study complete with multiple recommendations and make this available to the MNRF and the landowners. The study(ies) will focus on determining appropriate insurance coverage in several areas, including water quality monitoring and mitigation, land remediation, pollution and liability, prior to submitting its CAES application to the MNRF for approval.

Bedrock agrees that this is an important aspect of the pre-development phase of the project.

#### *Technical Submissions*

Bedrock has carefully reviewed the detailed list of items and application expectations set out by the MNRF on pages 9, 10 and 11 of the Draft Porous Rock O.Reg.

All of these items are reasonable and will properly form a part of any Bedrock CAES Application to the MNRF. As mentioned above herein, Bedrock is supportive of independent expert review of its application in a timely manner, and is willing to pay the reasonable costs of any such review(s).

#### *Notification and Engagement Requirements*

Bedrock submits that the MNRF's list of parties to be notified is acceptable and reasonable, as is the process and content offered in the notifications, and the timeframe for comment and response. Complete packages will be provided to each of the parties, where there is a mandatory full application package obligation, as this is seen by Bedrock to be a positive sign of transparency early in the development process.

Bedrock is keen to welcome First Nations as co-developers/project owners in their traditional territories; beyond our informal communications thus far, for which the identification process has been underway for several months, we are requesting a formal notification for a comprehensive consultation for those First Nations with traditional territories around the Bayfield – Grand Bend area. We look forward to this consultation and welcome any ideas and recommendations the MNRF has.

Bedrock will be pleased to provide the MRNF, as the Crown representative, with fulsome documentation and summaries of the project notification and engagement activities, as specified on page 12 of 15. Careful attention will be paid to ensure personal information will be securely managed.

#### **Insurance and Financial Security Requirements**

Bedrock has addressed the insurance study and the various related requirements above.

Respecting financial security requirements, Bedrock accepts that it is the responsibility of a project owner to post financial security to cover various project liabilities/costs, but it is critical to ensure that the obligation to do so, shall be at a time in the life cycle of the project, when it makes practical and economic sense, at a level that makes sense, and is supportable by the cash flows/revenues emanating from the project.

It is impossible to set aside a decommissioning fund before the project is financed, constructed or operational. The correct commercial time to set aside and accumulate these decommissioning and abandonment funds is when the project is operating and revenues are readily available to fund this obligation. This is normal commercial planning and this will be expected by the financing partners, irrespective of whether they be debt or equity participants.

Bedrock will commission an independent study to determine the cost of implementing the abandonment and decommissioning plan for each of its CAES projects. The criteria to assess/estimate the costs of abandonment and decommissioning, which are noted at the bottom of page 12 of 15, are acceptable to the extent that they can be known, forecast and assessed. At a minimum, if the MNRF is aware of other as-yet unspecified costs, the underlying rationale would be useful for any CAES project proponent to know and to consider a set-aside as a contingency, to minimize the unknowns in the development process.



Bedrock agrees that the form of security required can be established in the form of a trust, or irrevocable Letter of Credit (“LoC”). The amount of either funding vehicle should be accumulated only as the project reaches the point where revenues are available to set aside to support the abandonment or decommissioning; this requirement should also take into account that the total amount to undertake this obligation shall be completed and held irrevocably in the trust or LoC at least three years prior to the expected decommissioning date, in the event the CAES facility were to close earlier than its contract expiration, or when operations may cease earlier than anticipated.

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Thank you for the opportunity for Bedrock Energy Corp. to comment on the MNRF’s draft porous rock O.Reg.

Signed by:

A handwritten signature in black ink, appearing to read "S. Sangiuliano", followed by a long horizontal line extending to the right.

Stephen J Sangiuliano  
Director, Project Management