City Council
Regular Meeting
May 5, 2025 - 7:00 PM
City Hall Council Chambers

AGENDA

CALL TO ORDER

LAND ACKNOWLEDGEMENT

We would like to acknowledge the Federally Recognized Muckleshoot Indian Tribe, the ancestral keepers of the land we are gathered on today. We thank them for their immense contributions to our state and local history, culture, economy, and identity as Washingtonians.

PUBLIC PARTICIPATION

A. The Auburn City Council Meeting scheduled for Monday, May 5, 2025, at 7:00 p.m. will be held in person and virtually.

   Virtual Participation Link:
   To view the meeting virtually please click the below link, or call into the meeting at the phone number listed below. The link to the Virtual Meeting is:
   https://www.youtube.com/user/watchauburn/live/?nomobile=1

   To listen to the meeting by phone or Zoom, please call the number below or click the link:

   Telephone: 253 205 0468
   Toll Free: 888 475 4499
   Zoom: https://us06web.zoom.us/j/85214908964

PLEDGE OF ALLEGIANCE

ROLL CALL

ANNOUNCEMENTS, MAYOR'S PROCLAMATIONS, AND PRESENTATIONS

A. National Police Week and Peace Officers Memorial Day
   Mayor Backus to proclaim May 11 – May 17, 2025, as "National Police Week" and May 15, 2025, as “Peace Officers Memorial Day” in the City of Auburn

B. Professional Municipal Clerks Week
   Mayor Backus to proclaim May 4 – May 10, 2025, as “Professional Municipal Clerks Week” in the City of Auburn

C. Affordable Housing Week
   Mayor Backus to proclaim May 12 – May 16, 2025, as “Affordable Housing Week” in the City of Auburn

D. Asian American, Native Hawaiian and Pacific Islander Heritage Month
Mayor Backus to proclaim May 2025 as "Asian American, Native Hawaiian and Pacific Islander Heritage Month" in the City of Auburn

E. Jewish American Heritage Month
Mayor Backus to proclaim May 2025 as "Jewish American Heritage Month" in the City of Auburn

F. Older Americans Month
Mayor Backus to proclaim May 2025 as "Older Americans Month" in the City of Auburn

AGENDA MODIFICATIONS

PUBLIC HEARINGS

A. Public Hearing for Level 3 Communications, LLC Franchise Agreement No. FRN23-0004 (Gaub)
A Public Hearing to consider Franchise Agreement No. FRN23-0004 for Level 3 Communications, LLC

B. Public Hearing for Ordinance No. 6978 (Krum)
A Public Hearing to consider an Ordinance relating to the adoption of a 6-month moratorium for Energy Storage System facilities proposed to be located in the City of Auburn

AUDIENCE PARTICIPATION

This is the place on the agenda where the public is invited to speak to the City Council on any issue.

A. The public can participate in-person or submit written comments in advance.

Participants can submit written comments via mail, fax, or email. All written comments must be received prior to 5:00 p.m. on the day of the scheduled meeting and must be 350 words or less.
Please mail written comments to:
City of Auburn
Attn: Shawn Campbell, City Clerk
25 W Main St
Auburn, WA 98001

Please fax written comments to:
Attn: Shawn Campbell, City Clerk
Fax number: 253-804-3116

Email written comments to: publiccomment@auburnwa.gov

If an individual requires accommodation to allow for remote oral comment because of a difficulty attending a meeting of the governing body, the City requests notice of the need for accommodation by 5:00 p.m. on the day of the scheduled meeting. Participants can request accommodation to be able to provide a remote oral comment by contacting the City Clerk's Office in person, by phone (253) 931-3039, or by email (publiccomment@auburnwa.gov).

CORRESPONDENCE

COUNCIL AD HOC COMMITTEE REPORTS

Council Ad Hoc Committee Chairs may report on the status of their Ad Hoc Council Committees' progress on assigned tasks and may give their recommendation to the City Council, if any.

A. Council Rules of Procedure Ad Hoc Committee (Baldwin)

CONSENT AGENDA

All matters listed on the Consent Agenda are considered by the City Council to be routine and will be enacted by one motion in the form listed.

A. Minutes from the April 7 and 14, 2025, Special City Council Meetings

B. Minutes from the April 21, 2025, Regular City Council Meeting

C. Minutes from the April 28, 2025, Study Session Meeting

D. Claims Vouchers (Thomas)
Claims voucher list dated April 23, 2025, which includes voucher numbers 479540 through voucher 479696, in the amount of $2,277,895.89, nine electronic fund transfers in the amount of $18,186.08, and four wire transfers in the amount of $878,679.34

E. Payroll Voucher (Thomas)
Payroll check numbers 539673 through 539678 in the amount of $692,244.77, electronic deposit transmissions in the amount of $2,604,065.33, for a grand total of $3,296,310.10 for the period covering April 17, 2025, to April 30, 2025

(RECOMMENDED ACTION: Move to approve the Consent Agenda.)

UNFINISHED BUSINESS

NEW BUSINESS

ORDINANCES

A. Ordinance No. 6978 (Krum)
An Ordinance relating to adoption of a temporary 6-month moratorium on the acceptance, processing, and/or approval of applications for Building and Land Use Development Permits and related Land Use Decisions for Energy Storage System Facilities proposed to be located within the City of Auburn

(RECOMMENDED ACTION: Move to approve Ordinance No. 6978.)

RESOLUTIONS

A. Resolution No. 5825 (Hay)
A Resolution adopting the 2025-2029 Consolidated Plan and the 2025 Annual Action Plan

(RECOMMENDED ACTION: Move to adopt Resolution No. 5825.)

B. Resolution No. 5826 (Whalen)
A Resolution declaring certain Real Property as surplus and authorizing its disposal

(RECOMMENDED ACTION: Move to adopt Resolution No. 5826.)

C. Resolution No. 5827 (Martinson)
A Resolution authorizing the Mayor to terminate the Interlocal Agreement between the City of Auburn and King County to stand up the City of Auburn Municipal Court

(RECOMMENDED ACTION: Move to adopt Resolution No. 5827.)

D. Resolution No. 5830 (Gaub)
A Resolution authorizing the Mayor to execute and administer agreements between the City of Auburn and the Washington State Department of Commerce relating to Project No. CP2141, Downtown Auburn Theater

(RECOMMENDED ACTION: Move to adopt Resolution No. 5830.)

MAYOR AND COUNCILMEMBER REPORTS

At this time the Mayor and City Council may report on significant items associated with their appointed positions on federal, state, regional and local organizations.

A. From the Council

B. From the Mayor

ADJOURNMENT

Agendas and minutes are available to the public at the City Clerk's Office and on the City website (http://www.auburnwa.gov).

AGENDA BILL APPROVAL FORM

Agenda Subject:
Public Hearing for Level 3 Communications, LLC Franchise Agreement No. FRN23-0004 (Gaub)
A Public Hearing to consider Franchise Agreement No. FRN23-0004 for Level 3 Communications, LLC

Meeting Date:
May 5, 2025

Department:
Public Works

Attachments:
DRAFT Ordinance No. 6974

Budget Impact:

Administrative Recommendation:
City Council to hold a Public Hearing in consideration of Franchise Agreement No. FRN23-0004 for Level 3 Communications, LLC for a Fiber Optic Telecommunications Franchise.

Background for Motion:

Background Summary:
Section 20.04.040 of the Auburn City Code requires the City to hold a Public Hearing before granting or denying a Franchise Agreement. Franchise Agreement No. FRN23-0004 for Level 3 Communications, LLC will allow Level 3 to continue to operate their existing fiber optic telecommunications facilities within the City's public way.

The date of the Public Hearing was set by consent on April 21, 2025.

Councilmember: Tracy Taylor

Staff: Ingrid Gaub

ORDINANCE NO. 6974

AN ORDINANCE OF THE CITY COUNCIL OF THE CITY OF AUBURN, WASHINGTON, GRANTING TO LEVEL 3 COMMUNICATIONS, LLC, A FRANCHISE FOR FIBER OPTIC TELECOMMUNICATIONS.

WHEREAS, Level 3 Communications, LLC ("Franchisee") has applied for a non-exclusive Franchise for the right of entry, use, and occupation of certain public ways within the City of Auburn ("City"), expressly to install, construct, erect, operate, maintain, repair, relocate and remove its facilities in, on, over, under, along and/or across those public ways; and

WHEREAS, following proper notice, the City Council held a public hearing on Franchisee's request for a Franchise; and

WHEREAS, based on the information presented at such public hearing, and from facts and circumstances developed or discovered through independent study and investigation, the City Council now deems it appropriate and in the best interest of the City to grant the Franchise to Franchisee.

NOW, THEREFORE, THE CITY COUNCIL OF THE CITY OF AUBURN WASHINGTON, DO ORDAIN as follows:

Section 1. Definitions

For the purpose of this Franchise and the interpretation and enforcement thereof, definitions of words and phrases shall be in accordance with the definitions set forth in this Franchise and in Auburn City Code 20.02.020. If there is a conflict between any of the definitions set forth in this Franchise and the definitions set forth in Auburn City Code 20.02.020, the definitions in this Franchise shall govern to the extent of such conflict.

A. "ACC" means the Auburn City Code.

B. "Franchise" means this agreement approved by Ordinance No. 6974 of the City which authorizes Franchisee Facilities to provide Franchisee Services in the Franchise Area.

C. "Franchise Area" means the public ways specified in Exhibit "A".

D. “Franchisee’s Facilities” means fiber optic and broad band communications services constructed and operated within the public ways including all cables, wires, conduits, ducts, pedestals, and any associated converter equipment or other items necessary for Telecommunications Services as defined in RCW 35.99.010(7), that are located in the Franchise Area.

Franchisee’s Facilities do not include facilities used to provide wireless services, including antennas or other equipment, appliances, attachments and appurtenances associated with wireless telecommunications facilities. Franchisee’s facilities do not include small wireless facilities, microcell, minor facility, or small cell facilities, as defined in RCW 80.36.375. Franchisee’s facilities do not include any facilities that are not located within the Franchise Area or that are covered under a separate franchise agreement or agreement.

E. “Franchisee’s Services” means any telecommunications service, telecommunications capacity, or dark fiber, provided by the Franchisee using its Facilities, including, but not limited to, the transmission of voice, data or other electronic information, or other subsequently developed technology that carries a signal over fiber optic cable. Franchisee’s Services will also include non-switched, dedicated and private line, high capacity fiber optic transmission services to firms, businesses or institutions within the City and other lawful services not prohibited by this Ordinance. However, Franchisee’s Services will not include the provision of “cable services”, as defined by 47 U.S.C. §522, as amended, for which a separate franchise would be required.

Section 2. Grant of Right to Use Franchise Area

A. Subject to the terms and conditions stated in this Franchise, the City grants to the Franchisee general permission to enter, use, and occupy the Franchise Area, located within the incorporated area of the City. Franchisee may locate the Franchisee’s Facilities within the Franchise Area subject to all applicable laws, regulations, and permit conditions.

B. The Franchisee is authorized to install, remove, construct, erect, operate, maintain, relocate, upgrade, replace, restore, and repair Franchisee’s Facilities to provide Franchisee’s Services in the Franchise Area.

C. This Franchise does not authorize the use of the Franchise Area for any facilities or services other than Franchisee Facilities and Franchisee Services, and it extends no rights or privilege relative to any facilities or services of any type, including Franchisee Facilities and Franchisee Services, on public or private property elsewhere within the City.

D. This Franchise is non-exclusive and does not prohibit the City from entering into other agreements, including franchise agreements, impacting the Franchise Area, for any purpose that does not interfere with Franchisee's rights under this Franchise.

E. Except as explicitly set forth in this Franchise, this Franchise does not waive any rights that the City has or may acquire with respect to the Franchise Area or any other City roads, public ways, or property. This Franchise will be subject to the power of eminent domain, and in any proceeding under eminent domain, the Franchisee acknowledges its use of the Franchise Area shall have no value.

F. The City reserves the right to change, regrade, relocate, abandon, or vacate any public way within the Franchise Area. If, at any time during the term of this Franchise, the City vacates any portion of the Franchise Area containing Franchisee Facilities, the City may reserve an easement for public utilities within that vacated portion, pursuant to Chapter 35.79.030 RCW, within which the Franchisee may continue to operate any existing Franchisee Facilities under the terms of this Franchise for the remaining period set forth under Section 4.

G. The Franchisee agrees that its use of Franchise Area shall at all times be subordinated to and subject to the City and the public's need for municipal infrastructure, travel, and access to the Franchise Area, except as may be otherwise required by law.

H. The Franchisee agrees to provide the City with complete contact information for any client, lessee, sub-lessee, customer, or other entity that Franchisee allows to utilize, control, access, or otherwise provides services to, who will also use the Franchisee Facilities to provide services to their clients and customers either inside or outside the City limits. Such contact information shall be provided to the City a minimum of sixty (60) days prior to the start of such anticipated use so that the City may determine if Franchisee's client, lessee, sub-lessee, customer, or other entity is required to obtain a franchise agreement with the City prior to such use. If the client, lessee, sub-lessee, customer, or other entity is required to obtain a franchise agreement with the City, then the Franchisee shall not allow use, control, access, or otherwise provide services to such entity until the required franchise agreement has been obtained.

Section 3. Notice

A. Written notices to the parties shall be sent by a nationally recognized overnight courier or by certified mail to the following addresses, unless a different address is designated in writing and delivered to the other party. Any such notice

shall become effective upon receipt by certified mail, confirmed delivery by overnight courier, or the date stamped received by the City. Any communication made by e-mail or similar method will not constitute notice pursuant to this Franchise, except in case of emergency notification.

City: Right-of-Way Specialist,
Public Works Department - Transportation
City of Auburn
25 West Main Street
Auburn, WA 98001-4998
Telephone: (253) 931-3010
Email Address: rowusepermit@auburnwa.gov

with a copy to: City Clerk
City of Auburn
25 West Main Street
Auburn, WA 98001-4998

Franchisee: Level 3 Communications, LLC
Attn: James Nickerson
5325 Zuni Street
Denver, CO 80221
Telephone: (720) 888-4429
Email Address: james.nickerson@lumen.com

with a copy to: Level 3 Communications, LLC
Attn: James Nickerson
931 14th Street
Denver, CO 80202
Telephone: (720) 888-4429
Email Address: james.nickerson@lumen.com

B. Any changes to the above-stated Franchisee information shall be sent to the City's Right-of-Way Specialist, Public Works Department – Transportation Division, with copies to the City Clerk, referencing the title of this Franchise.

C. The above-stated Franchisee voice telephone numbers shall be staffed at least during normal business hours, Pacific time zone. The City may contact Franchisee at the following number for emergency or other needs outside of normal business hours of the Franchisee: (877) 453-8353.

Section 4. Term of Franchise

A. This Franchise shall run for a period of fifteen (15) years, from the date of Franchise Acceptance as described in Section 5 of this Franchise.

B. Automatic Extension. If the Franchisee fails to formally apply for a new franchise agreement prior to the expiration of this Franchise's term or any extension thereof, this Franchise automatically continues month to month until a new franchise agreement is applied for and approved under the then current process or until either party gives written notice at least one hundred and eighty (180) days in advance of intent to cancel this Franchise.

Section 5. Acceptance of Franchise

A. This Franchise will not become effective until Franchisee files with the City Clerk (1) the Statement of Acceptance (Exhibit "B"), (2) all verifications of insurance coverage specified under Section 16, (3) the financial security specified in Section 17, and (4) payment of any outstanding application fees required in the City Fee Schedule. These four items will collectively be the "Franchise Acceptance". The date that such Franchise Acceptance is filed with the City Clerk will be the effective date of this Franchise.

B. If the Franchisee fails to file the Franchise Acceptance with the City Clerk within thirty (30) days after the effective date of the ordinance approving the Franchise as described in Section 28 of this Franchise, the City's grant of the Franchise will be null and void.

Section 6. Construction and Maintenance

A. The Franchisee shall apply for, obtain, and comply with the terms of all permits required under applicable law for any work done within the City. Franchisee will comply with all applicable City, State, and Federal codes, rules, regulations, and orders in undertaking such work.

B. Franchisee agrees to coordinate its activities with the City and all other utilities located within the public way within which Franchisee is undertaking its activity.

C. The City expressly reserves the right to prescribe how and where Franchisee's Facilities will be installed within the public way and may require the removal, relocation and/or replacement thereof in the public interest and safety at the expense of the Franchisee as provided for in Chapter 35.99 RCW.

D. Before beginning any work within the public way, the Franchisee will comply with the One Number Locator provisions of Chapter 19.122 RCW to identify existing utility infrastructure.

E. Tree Trimming. Upon prior written approval of the city the Franchisee shall have the authority to trim trees upon and overhanging streets, public ways and places in the Franchise Area so as to prevent the branches of such trees from coming in physical contact with the Franchisee's Facilities. Franchisee shall be responsible for debris removal from such activities. If such debris is not removed within 24 hours, the City may, at its sole discretion, remove such debris and charge the Franchisee for the cost thereof. This section does not, in any instance, grant automatic authority to clear vegetation for purposes of providing a clear path for radio signals. Any such general vegetation clearing will require other permits as necessary from the City.

Section 7. Trench Repair for Street Restorations

A. At any time during the term of this Franchise, if a Franchisee Facility or trench within the Franchise Area causes a street to crack, settle, or otherwise fail, the City will notify Franchisee of the deficiency and Franchisee agrees to restore the deficiency and repair the damage within thirty (30) days of written notice by the City.

B. For purposes of the Section, "street" shall mean all City owned improvements within a public way, including, but not limited to, the following: pavement, sidewalks, curbing, above and below-ground utility facilities, and traffic control devices.

Section 8. Repair and Emergency Work

In the event of an emergency, the Franchisee may commence repair and emergency response work as required under the circumstances. The Franchisee will notify the City telephonically during normal business hours (at 253-931-3010) and during non-business hours (at 253-876-1985) as promptly as possible, before such repair or emergency work commences, and in writing as soon thereafter as possible. Such notification shall include the Franchisee's emergency contact phone number for corresponding response activity. The City may commence emergency response work, at any time, without prior written notice to the Franchisee, but will notify the Franchisee in writing as promptly as possible under the circumstances. Franchisee will reimburse the City for the City's actual cost of performing emergency response work.

Section 9. Damages to City and Third-Party Property

Franchisee agrees that if any of its actions, or the actions of any person, agent, or contractor acting on behalf of the Franchisee under this Franchise impairs or damages any City property, survey monument, or property owned by a third-party, Franchisee will restore, at its own cost and expense, the property to a safe condition. Upon returning the property to a safe condition, the property shall then be returned to the condition it was in immediately prior to being damaged (if the safe condition of the property is not the same as that which existed prior to damage). All repair work shall be performed and completed to the satisfaction of the City Engineer.

Section 10. Location Preference

A. Any structure, equipment, appurtenance or tangible property of a utility or other franchisee, other than the Franchisee's, which was installed, constructed, completed or in place prior in time to Franchisee's application for a permit to construct or repair Franchisee's Facilities under this Franchise shall have preference as to positioning and location with respect to the Franchisee's Facilities. However, to the extent that the Franchisee's Facilities are completed and installed before another utility or other franchisee's submittal of a permit for new or additional structures, equipment, appurtenances, or tangible property, then the Franchisee's Facilities will have priority. These rules governing preference shall continue when relocating or changing the grade of any City road or public way. A relocating utility or franchisee will not cause the relocation of another utility or franchisee that otherwise would not require relocation. This Section will not apply to any City facilities or utilities that may in the future require the relocation of Franchisee's Facilities. Such relocations will be governed by Section 11 and Chapter 35.99 RCW.

B. Franchisee will maintain a minimum underground horizontal separation of five (5) feet from City water, sanitary sewer and storm sewer facilities and ten (10) feet from above-ground City water facilities; provided, that for development of new areas, the City, in consultation with Franchisee and other utility purveyors or authorized users of the public way, will develop guidelines and procedures for determining specific utility locations.

Section 11. Relocation of Franchisee Facilities

A. Except as otherwise so required by law, Franchisee agrees to relocate, remove, or reroute its facilities as ordered by the City Engineer at no expense or liability to the City, except as may be required by Chapter 35.99 RCW. Pursuant to the provisions of Section 15, Franchisee agrees to protect and save

harmless the City from any customer or third-party claims for service interruption or other losses in connection with any such change, relocation, abandonment, or vacation of the public way.

B. If a readjustment or relocation of the Franchisee Facilities is necessitated by a request from a party other than the City, that party shall pay the Franchisee the actual costs associated with such relocation.

Section 12. Abandonment and or Removal of Franchisee Facilities

A. Within one hundred and eighty days (180) of Franchisee's permanent cessation of use of the Franchisee's Facilities, the Franchisee will, at the City's discretion, either abandon in place or remove the affected facilities.

B. Franchisee may ask the City in writing to abandon, in whole or in part, all or any part of the Franchisee's Facilities. Any plan for abandonment of Franchisee Facilities must be approved in writing by the City.

C. The parties expressly agree that this Section will survive the expiration, revocation or termination of this Franchise.

Section 13. Undergrounding

A. The parties agree that this Franchise does not limit the City's authority under federal law, state law, or local ordinance, to require the undergrounding of utilities.

B. Whenever the City requires the undergrounding of aerial utilities in the Franchise Area, the Franchisee will underground the Franchisee's Facilities in the manner specified by the City Engineer at no expense or liability to the City, except as may be required by Chapter 35.99 RCW. Where other utilities are present and involved in the undergrounding project, Franchisee will only be required to pay its fair share of common costs borne by all utilities, in addition to the costs specifically attributable to the undergrounding of Franchisee's Facilities. Common costs will include necessary costs for common trenching and utility vaults. Fair share will be determined in comparison to the total number and size of all other utility facilities being undergrounded.

Section 14. Franchisee Information

A. Franchisee agrees to supply, at no cost to the City, any information reasonably requested by the City to coordinate municipal functions with Franchisee's activities and fulfill any municipal obligations under state law. Said

information will include, at a minimum, as-built drawings of Franchisee's Facilities, installation inventory, and maps and plans showing the location of existing or planned facilities within the City. Said information may be requested either in hard copy or electronic format, compatible with the City's data base system, including the City's Geographic Information System (GIS) data base. Franchisee will keep the City informed of its long-range plans for coordination with the City's long-range plans.

B. The parties understand that Chapter 42.56 RCW and other applicable law may require public disclosure of information given to the City.

Section 15. Indemnification and Hold Harmless

A. Franchisee shall defend, indemnify, and hold harmless the City, its officers, officials, employees and volunteers from and against any and all claims, suits, actions, or liabilities for injury or death of any person, or for loss or damage to property, which arises out of Franchisee's acts, errors or omissions, or from the conduct of Franchisee's business, or from any activity, work or thing done, permitted, or suffered by Franchisee arising from or in connection with this Franchise, except only such injury or damage as shall have been occasioned by the sole negligence of the City, its officers, officials, employees, and volunteers.

However, should a court of competent jurisdiction determine that this Franchise is subject to RCW 4.24.115, then, in the event of liability for damages arising out of bodily injury to persons or damages to property caused by or resulting from the concurrent negligence of the Franchisee and the City, its officers, officials, employees, and volunteers, the Franchisee's liability hereunder shall be only to the extent of the Franchisee's negligence. It is further specifically and expressly understood that the indemnification provided herein constitutes the Franchisee's waiver of immunity under Industrial Insurance, Title 51 RCW, solely for the purposes of this indemnification. This waiver has been mutually negotiated by the parties. The provisions of this section shall survive the expiration or termination of this Franchise.

B. The Franchisee will hold the City harmless from any liability arising out of or in connection with any damage or loss to the Franchisee's Facilities caused by maintenance and/or construction work performed by, or on behalf of, the City within the Franchise Area or any other City road, public way, or other property, except to the extent any such damage or loss is directly caused by the negligence of the City, or its agents, its officers, officials, employees, and volunteers performing such work.

C. The Franchisee acknowledges that neither the City nor any other public agency with responsibility for firefighting, emergency rescue, public safety or similar duties within the City has the capability to provide trench, close trench or confined space rescue. The Franchisee, and its agents, assigns, successors, or contractors, will make such arrangements as Franchisee deems fit for the provision of such services. The Franchisee will hold the City harmless from any liability arising out of or in connection with any damage or loss to the Franchisee for the City's failure or inability to provide such services, and, pursuant to the terms of Section 15(A), the Franchisee will indemnify the City against any and all third-party costs, claims, injuries, damages, losses, suits, or liabilities based on the City's failure or inability to provide such services.

Section 16. Insurance

A. The Franchisee shall procure and maintain for the duration of this Franchise and as long as Franchisee has Facilities in the public way, insurance against claims for injuries to persons or damage to property which may arise from or in connection with the Franchise and use of the public way.

B. No Limitation. The Franchisee's maintenance of insurance as required by this Franchise shall not be construed to limit the liability of the Franchisee to the coverage provided by such insurance or otherwise limit the City's recourse to any remedy available at law or in equity.

C. Minimum Scope of Insurance. The Franchisee shall obtain insurance of the types and coverage described below:

1. Commercial General Liability insurance shall be at least as broad as Insurance Services Office (ISO) occurrence form CG 00 01 and shall cover liability arising from premises, operations, stop gap liability, independent contractors, products-completed operations, personal injury and advertising injury, and liability assumed under an insured contract. There shall be no exclusion for liability arising from explosion, collapse or underground property damage. The City shall be included as an additional insured under the Franchisee's Commercial General Liability insurance policy with respect this Franchise using ISO endorsement CG 20 12 05 09 if the Franchise is considered a master permit as defined by RCW 35.99.010, or CG 20 26 07 04 if it is not, or substitute endorsement providing at least as broad coverage.

2. Automobile Liability insurance covering all owned, non-owned, hired and leased vehicles. Coverage shall be at least as broad as ISO form CA 00 01.

3. Contractors Pollution Liability insurance shall be in effect throughout the entire Franchise covering losses caused by pollution conditions that arise from the operations of the Franchisee. Contractors Pollution Liability shall cover bodily injury, property damage, cleanup costs and defense, including costs and expenses incurred in the investigation, defense, or settlement of claims.

4. Workers' Compensation coverage as required by the Industrial Insurance laws of the State of Washington.

5. Excess or Umbrella Liability insurance shall be excess over and at least as broad in coverage as the Franchisee's Commercial General Liability and Automobile Liability insurance. The City shall be included as an additional insured on the Franchisee's Excess or Umbrella Liability insurance policy.

D. Minimum Amounts of Insurance. The Franchisee shall maintain insurance that meets or exceeds the following limits:

1. Commercial General Liability insurance shall be written with limits no less than $5,000,000 each occurrence, $5,000,000 general aggregate.

2. Automobile Liability insurance with a minimum combined single limit for bodily injury and property damage of $5,000,000 per accident.

3. Contractors Pollution Liability insurance shall be written in an amount of at least $2,000,000 per loss, with an annual aggregate of at least $2,000,000.

4. Workers' Compensation coverage as required by the Industrial Insurance laws of the State of Washington and employer's liability insurance with limits of not less than $1,000,000.

5. Excess or Umbrella Liability insurance shall be written with limits of not less than $5,000,000 per occurrence and annual aggregate. The Excess or Umbrella Liability requirement and limits may be satisfied instead through Franchisee's Commercial General Liability and Automobile Liability insurance, or any combination thereof that achieves the overall required limits.

E. Other Insurance Provisions. Franchisee's Commercial General Liability, Automobile Liability, Excess or Umbrella Liability, Contractors Pollution Liability insurance policy or policies are to contain, or be endorsed to contain, that they shall be primary insurance as respect to the City. Any insurance, self-insurance, or self-insured pool coverage maintained by the City shall be excess of the Franchisee's insurance and shall not contribute with it.

F. Acceptability of Insurers. Insurance is to be placed with insurers with a current A.M. Best rating of not less than A: VII.

G. Subcontractors. The Franchisee shall cause each and every Subcontractor to provide insurance coverage that complies with all applicable requirements of the Franchisee-provided insurance as set forth herein, including limits no less than what is required of Franchisee under this Franchise. The Franchisee shall ensure that the City is an additional insured on each and every Subcontractor's Commercial General liability insurance policy using an endorsement as least as broad as ISO CG 20 26.

H. Verification of Coverage. The Franchisee shall furnish the City with certificates and a copy of the amendatory endorsements, including but not necessarily limited to the additional insured endorsement, evidencing the insurance requirements of this Franchise. Upon request by the City in the event of a claim giving rise to a coverage dispute, the Franchisee shall furnish certified copies of all required applicable insurance policies involved in such dispute, including endorsements, required in this Franchise and evidence of all subcontractors' coverage.

I. Notice of Cancellation. Franchisee shall provide the City with written notice of any policy cancellation within two business days of their receipt of such notice.

J. Failure to Maintain Insurance. Failure on the part of the Franchisee to maintain the insurance as required shall constitute a material breach of the Franchise, upon which the City may, after giving five business days' notice to the Franchisee to correct the breach, terminate the Franchise.

K. City Full Availability of Franchisee Limits. If the Franchisee maintains higher insurance limits than the minimums shown above, the City shall be insured for the full available limits of Commercial General and Excess or Umbrella liability maintained by the Franchisee, irrespective of whether such limits maintained by the Franchisee are greater than those required by this Franchise or whether any certificate of insurance furnished to the City evidences limits of liability lower than those maintained by the Franchisee.

L. Franchisee – Self-Insurance. Franchisee will have the right to self-insure any or all of the above-required insurance. Any such self-insurance is subject to approval by the City. If the Franchisee is self-insured or becomes self-insured during the term of the Franchise, Franchisee or its affiliated parent entity shall comply with the following: (i) Franchisee shall submit a letter to the City stating which of the above required insurance provisions in this Section 15 Franchisee proposes to self-insure; (ii) provide the City, upon request, a copy of Franchisee's or its parent company's most recent audited financial statements, if such financial statements are not otherwise publicly available; (iii) Franchisee or its parent company is responsible for all payments within the self-insured retention; and (iv) Franchisee assumes all defense and indemnity obligations as outlined in Section 15.

Section 17. Financial Security

The Franchisee will provide the City with a financial security in the amount of Fifty Thousand Dollars ($50,000.00) running for, or renewable for, the term of this Franchise, in a form and substance acceptable to the City. If Franchisee fails to substantially comply with any one or more of the provisions of this Franchise, the City may recover jointly and severally from the principal and any surety of that financial security any damages suffered by the City as a result Franchisee's failure to comply, including but not limited to staff time, material and equipment costs, compensation or indemnification of third parties, and the cost of removal or abandonment of facilities. Franchisee specifically agrees that its failure to comply with the terms of Section 20 will constitute damage to the City in the monetary amount set forth in that section. Any financial security will not be construed to limit the Franchisee's liability to the security amount, or otherwise limit the City's recourse to any remedy to which the City is otherwise entitled at law or in equity.

Section 18. Successors and Assignees

A. All the provisions, conditions, regulations and requirements contained in this Franchise are binding upon the successors, assigns of, and independent contractors of the Franchisee, and all rights and privileges, as well as all obligations and liabilities of the Franchisee will inure to its successors, assignees and contractors equally as if they were specifically mentioned herein wherever the Franchisee is mentioned.

B. This Franchise will not be leased, assigned or otherwise alienated without the express prior consent of the City by ordinance, which shall not be unreasonably denied, conditioned or delayed.

C. Franchisee and any proposed assignee or transferee will provide and certify the following to the City not less than ninety (90) days prior to the proposed date of transfer: (1) Complete information setting forth the nature, term and conditions of the proposed assignment or transfer; (2) All information required by the City of an applicant for a Franchise with respect to the proposed assignee or transferee; and, (3) An application fee in the amount established by the City's fee schedule, plus any other costs actually and reasonably incurred by the City in processing, and investigating the proposed assignment or transfer.

D. Before the City's consideration of a request by Franchisee to consent to a Franchise assignment or transfer, the proposed Assignee or Transferee will file with the City a written promise to unconditionally accept all terms of the Franchise, effective upon such transfer or assignment of the Franchise. The City is under no obligation to undertake any investigation of the transferor's state of compliance and failure of the City to insist on full compliance before transfer does not waive any right to insist on full compliance thereafter.

Section 19. Dispute Resolution

A. In the event of a dispute between the City and the Franchisee arising by reason of this Franchise, the dispute will first be referred to the operational officers or representatives designated by City and Franchisee to have oversight over the administration of this Franchise. The officers or representatives will meet within thirty (30) calendar days of either party's request for a meeting, whichever request is first, and the parties will make a good faith effort to achieve a resolution of the dispute.

B. If the parties fail to achieve a resolution of the dispute in this manner, either party may then pursue any available judicial remedies. This Franchise will be governed by and construed in accordance with the laws of the State of Washington. If any suit, arbitration, or other proceeding is instituted to enforce any term of this Franchise, the parties specifically understand and agree that venue will be exclusively in King County, Washington. The prevailing party in any such action will be entitled to its attorneys' fees and costs.

Section 20. Enforcement and Remedies

A. If the Franchisee willfully violates or fails to comply with any of the provisions of this Franchise through willful or unreasonable negligence or fails to comply with any notice given to Franchisee under the provisions of this Franchise, the City may, at its discretion, provide Franchisee with written notice to cure the breach within thirty (30) days of notification. If the parties determine the breach cannot be cured within thirty days, the City may specify a longer cure period and

condition the extension of time on Franchisee's submittal of a plan to cure the breach within the specified period, commencement of work within the original thirty-day cure period, and diligent prosecution of the work to completion. If the breach is not cured within the specified time, or the Franchisee does not comply with the specified conditions, the City may, at its discretion, either (1) revoke the Franchise with no further notification, or (2) claim damages of Two Hundred Fifty Dollars ($250.00) per day against the financial guarantee set forth in Section 17 for every day after the expiration of the cure period that the breach is not cured.

B. If the City determines that Franchisee is acting beyond the scope of permission granted in this Franchise for Franchisee Facilities and Franchisee Services, the City reserves the right to cancel this Franchise and require the Franchisee to apply for, obtain, and comply with all applicable City permits, franchises, or other City permissions for such actions, and if the Franchisee's actions are not allowed under applicable federal and state or City laws, to compel Franchisee to cease those actions.

Section 21. Compliance with Laws and Regulations

A. This Franchise is subject to, and the Franchisee will comply with all applicable federal and state or City laws, regulations and policies (including all applicable elements of the City's comprehensive plan), in conformance with federal laws and regulations, affecting performance under this Franchise. The Franchisee will be subject to the police power of the City to adopt and enforce general ordinances necessary to protect the safety and welfare of the general public in relation to the rights granted in the Franchise Area.

B. The City reserves the right at any time to amend this Franchise to conform to any federal or state statute or regulation relating to the public health, safety, and welfare, or relating to roadway regulation, or a City Ordinance enacted pursuant to such federal or state statute or regulation enacted, amended, or adopted after the effective date of this Franchise if it provides Franchisee with thirty (30) days written notice of its action setting forth the full text of the amendment and identifying the statute, regulation, or ordinance requiring the amendment. The amendment will become automatically effective on expiration of the notice period unless, before expiration of that period, the Franchisee makes a written call for negotiations over the terms of the amendment. If the parties do not reach agreement as to the terms of the amendment within thirty (30) days of the call for negotiations, the City may enact the proposed amendment, by incorporating the Franchisee's concerns to the maximum extent the City deems possible.

C. The City may terminate this Franchise upon thirty (30) days written notice to the Franchisee, if the Franchisee fails to comply with such amendment or modification.

Section 22. License, Tax and Other Charges

This Franchise will not exempt the Franchisee from any future license, tax, or charge which the City may adopt under authority granted to it under state or federal law for revenue or as reimbursement for use and occupancy of the Franchise Area.

Section 23. Consequential Damages Limitation

Notwithstanding any other provision of this Franchise, in no event will either party be liable for any special, incidental, indirect, punitive, reliance, consequential or similar damages.

Section 24. Severability

If any portion of this Franchise is deemed invalid, the remainder portions will remain in effect.

Section 25. Titles

The section titles used are for reference only and should not be used for the purpose of interpreting this Franchise.

Section 26. Implementation

The Mayor is authorized to implement those administrative procedures necessary to carry out the directions of this legislation.

Section 27. Entire Franchise

This Franchise, as subject to the appropriate city, state, and federal laws, codes, and regulations, and the attachments hereto represent the entire understanding and agreement between the parties with respect to the subject matter and it supersedes all prior oral negotiations between the parties. All previous franchises between the parties pertaining to Franchisee's operation of its Facilities are hereby superseded.

DRAFT

Section 28. Effective Date.

This Ordinance will take effect and be in force five days from and after its passage, approval and publication as provided by law.

INTRODUCED: _____
PASSED: _____
APPROVED: _____

_____
NANCY BACKUS, MAYOR

ATTEST:

_____
Shawn Campbell, MMC, City Clerk

APPROVED AS TO FORM:

_____
Jason Whalen, City Attorney

PUBLISHED: _____

DRAFT

EXHIBIT “A”

FRANCHISE AREA

Level 3 Communications LLC Franchisee Facilities are located in the Union Pacific Railroad Road property that runs north/south through the City and occupies City public way through seven east/west road crossings installed pursuant to City of Auburn Public Way Agreement No. 99-04, Ordinance No. 5333 effective January 13, 2000. The specific crossing locations that make up the Franchise Area are adjacent to the Union Pacific Rail line and are as follows:

1. Crossing at S 277th Street, 60 Feet.
2. Crossing S 285th Street (aka 44th Street NW), 60 feet.
3. Crossing 37th Street NW, 60 feet.
4. Crossing 29th Street NW, 50 feet.
5. Crossing 15th Street NW, 260 feet.
6. Crossing West Main Street, 60 feet.
7. Crossing 15th Street SW, 100 feet.

DRAFT

EXHIBIT “B”

STATEMENT OF ACCEPTANCE

Level 3 Communications, LLC, for itself, its successors and assigns, hereby accepts and agrees to be bound by all lawful terms, conditions and provisions of the Franchise attached hereto and incorporated herein by this reference.

Franchisee Name: Level 3 Communications, LLC
Address: _____
City, State, Zip: _____

By: _____ Date: _____
Signature

Name: _____
Title: _____

STATE OF _____)
)ss.
COUNTY OF _____)

On this ____ day of _____, 20__, before me the undersigned, a Notary Public in and for the State of _____, duly commissioned and sworn, personally appeared, _____ of _____, the company that executed the within and foregoing instrument, and acknowledged the said instrument to be the free and voluntary act and deed of said company, for the uses and purposes therein mentioned, and on oath stated that they are authorized to execute said instrument.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my official seal on the date hereinabove set forth.

_____
Signature

_____
NOTARY PUBLIC in and for the State of
_____, residing at _____

MY COMMISSION EXPIRES: _____

DRAFT

AGENDA BILL APPROVAL FORM

Agenda Subject:
Public Hearing for Ordinance No. 6978 (Krum)
A Public Hearing to consider an Ordinance relating to the adoption of a 6-month moratorium for Energy Storage System facilities proposed to be located in the City of Auburn

Meeting Date:
May 5, 2025

Department:
Community Development

Attachments:
None

Budget Impact:

Administrative Recommendation:
City Council to hold a Public Hearing in consideration of a proposed temporary 6-month moratorium on the acceptance, processing, and/or approval of applications for Building and Land Use Development Permits and related Land Use Decisions for Energy Storage System Facilities proposed to be located within the City of Auburn.

Background for Motion:

Background Summary:
See Ordinance No. 6978 for materials.

Councilmember: Tracy Taylor

Staff: Jason Krum

AGENDA BILL APPROVAL FORM

Agenda Subject:
Minutes from the April 7 and 14, 2025, Special City Council Meetings

Meeting Date:
May 5, 2025

Department:
City Council

Attachments:
04-07-2025 Special Meeting Minutes, 04-14-2025 Special Meeting Minutes

Budget Impact:

Administrative Recommendation:

Background for Motion:

Background Summary:

Councilmember:

Staff:

City Council
Special Meeting
April 7, 2025 - 5:30 PM
City Hall Council Chambers

MINUTES

CALL TO ORDER

Mayor Backus called the meeting to order at 7:00 p.m. in the Council Chambers of Auburn City Hall, 25 West Main Street.

LAND ACKNOWLEDGEMENT

Mayor Backus acknowledged the Federally Recognized Muckleshoot Indian Tribe as the ancestral keepers of the land we are gathered on today.

PUBLIC PARTICIPATION

The Special City Council Meeting was held in person and virtually.

PLEDGE OF ALLEGIANCE

Mayor Backus led those in attendance in the Pledge of Allegiance.

ROLL CALL

Councilmembers present: Deputy Mayor Cheryl Rakes, Hanan Amer, Kate Baldwin, Clinton Taylor, Tracy Taylor, and Yolanda Trout-Manuel.

Mayor Nancy Backus and the following staff members present included: Senior City Staff Attorney Taryn Jones, Chief of Police Mark Caillier, Assistant Director of Community Development Steve Sturza, Director of Human Services Kent Hay, Director of Parks, Arts, and Recreation Julie Krueger and City Clerk Shawn Campbell.

ANNOUNCEMENTS, MAYOR'S PROCLAMATIONS, AND PRESENTATIONS

A. Spirit Fest Recognition Day

Mayor Backus proclaimed April 1, 2025, as "Spirit Fest Recognition Day" in the City of Auburn.

The representatives from Spirit Fest thanked the Mayor and Council for their recognition and recognized all the volunteers in the audience.

B. Arbor Day

Mayor Backus proclaimed April 16, 2025, as "Arbor Day" in the City of Auburn.

Bryce Landrud, Chair of the Urban Tree Board, accepted the proclamation and thanked the Mayor and Council for their support.

C. National Public Safety Telecommunicators Week

Mayor Backus proclaimed April 13, 2025, through April 16, 2025, as "National Public Safety Telecommunicators Week" in the City of Auburn.

Vonnie Mayer and Sheryl Kowalczik with Valley Communications accepted the proclamation and thanked the Mayor and Council for the recognition of the staff at Valley Communications.

D. Sexual Assault Awareness Month

Mayor Backus proclaimed April 2025, as "Sexual Assault Awareness Month" in the City of Auburn.

E. Sikh Heritage Month

Mayor Backus proclaimed April 2025 as "Sikh Heritage Month" in the City of Auburn.

Jaskaran Singh Sarao and members of the community accepted the proclamation and thanked the Mayor and Council for their support and recognition.

APPOINTMENTS

A. Planning Commission
City Council to approve the appointment of Kirk Hiller to the Planning Commission for a three-year term expiring December 31, 2027

Deputy Mayor Rakes moved and Councilmember C. Taylor seconded to approve the appointment of Kirk Hiller to the Planning Commission for a three-year term expiring December 31, 2027.

MOTION CARRIED UNANIMOUSLY. 6-0

AUDIENCE PARTICIPATION

Written Comments:

Keoni Perez, Auburn
Keoni expressed frustration regarding the vacant Council position application deadline and provided comments regarding the Pacific Islander community in Auburn.

In-Person Comments:

Mark Celich, Auburn
Mark expressed concerns regarding HPM's.

Skylar Nickals, Auburn
Skylar expressed frustration at not being selected to move forward to the second phase of the selection process for the vacant Council position.

Virginia Haugen, Auburn
Virginia expressed appreciation for groups that feed the community.

CORRESPONDENCE
There was no correspondence for Council to review.

COUNCIL AD HOC COMMITTEE REPORTS

A. Council Rules of Procedure Ad Hoc Committee (Baldwin)

Councilmember Baldwin, Chair of the Council Rules of Procedure Ad Hoc Committee, reported that the Committee is working through each section of the Rules of Procedure.

CONSENT AGENDA

A. Minutes from the March 17, 2025, City Council Meeting

B. Minutes from the March 24 and 31, 2025, Study Session Meetings

C. Claims Vouchers (Thomas)
Claims voucher list dated March 26, 2025 which includes voucher numbers 479283 through voucher 479398, in the amount of $6,300,440.62, nine electronic fund transfers in the amount of $21,676.37, and two wire transfers in the amount of $894,239.65

D. Payroll Voucher (Thomas)
Payroll check numbers 539663 through 539665 in the amount of $686,280.97, electronic deposit transmissions in the amount of $2,839,244.09, for a grand total of $3,525.525.06 for the period covering March 13, 2025 to April 2, 2025

Deputy Mayor Rakes moved and Councilmember Baldwin seconded to approve the consent agenda.

MOTION CARRIED UNANIMOUSLY. 6-0

ORDINANCES

A. Ordinance No. 6972 (Krum)
An Ordinance amending Sections 16.06.020, 16.06.055 and 16.06.130 and adding Sections 16.06.085 and 16.06.095 of the Auburn City Code relating to the State Environmental Policy Act

Councilmember T. Taylor moved and Councilmember Trout-Manual seconded to approve Ordinance No. 6972.

MOTION CARRIED UNANIMOUSLY. 6-0

B. Ordinance No. 6976 (Krum)
An Ordinance amending the Comprehensive Zoning Map

Councilmember T. Taylor moved and Councilmember Baldwin seconded to approve Ordinance No. 6976.

MOTION CARRIED UNANIMOUSLY. 6-0

RESOLUTIONS

A. Resolution No. 5820 (Caillier)
A Resolution accepting a Grant Award from the Seattle Police Department on behalf of the Washington State Internet Crimes Against Children Task Force

Deputy Mayor Rakes moved and Councilmember Amer seconded to adopt Resolution No. 5820.

MOTION CARRIED UNANIMOUSLY. 6-0

EXECUTIVE SESSION

Mayor Backus adjourned into executive session at 6:20 p.m. per RCW 42.30.110(1)(h) to evaluate the qualifications of a candidate for appointment to elective office. However, any interview of such candidate and final action appointing a candidate to elective office shall be in a meeting open to the public for 30 minutes. In addition to Mayor Backus, Councilmembers and Senior City Staff Attorney Jones were required to attend.

Mayor Backus reconvened the meeting at 7:45 p.m.

COUNCIL POSITION VACANCY

A. Council to Select Candidates to Interview for Vacant Position (Council)

Councilmember T. Taylor moved and Deputy Mayor Rakes seconded to interview six candidates during the April 14, 2025, Special City Council Meeting.

Councilmember Amer moved and Councilmember Baldwin seconded to amend the motion to interview seven candidates.

MOTION CARRIED. 4-2, Councilmembers C. Taylor and T. Taylor voted against.

Council discussed staff time, and increasing the number of applicants to ten.

Councilmember Baldwin moved and Councilmember Trout-Manuel seconded to amend the previous amendment motion to interview ten candidates.

MOTION FAILED. 2-4

Council discussed the amount of time it takes to interview each candidate and Mayor Backus reviewed the interview process.

AMENDED MOTION CARRIED. 4-2, Councilmembers C. Taylor and T. Taylor voted against.

Mayor Backus recessed the meeting for five minutes at 7:59 p.m. She reconvened the meeting at 8:05 p.m.

Mayor Backus called each applicant's number and asked Council for comments and votes for this person to move forward with the interview process.

Candidates moving forward are Candidate No's. 21, 29, 32, 35, 38, 41 and 45.

Council discussed the time for the interviews.

Councilmember Amer moved and Councilmember C. Taylor seconded to limit the time of each interview to 20 minutes.

Councilmember T. Taylor moved and Councilmember Baldwin seconded to amend the motion to limit the time of each interview to 25 minutes.
MOTION CARRIED UNANIMOUSLY. 6-0

AMENDED MOTION CARRIED UNANIMOUSLY. 6-0

Councilmember Baldwin moved and Councilmember Amer seconded to reduce the introduction time from 10 minutes to 5 minutes.

MOTION CARRIED UNANIMOUSLY. 6-0

MAYOR AND COUNCILMEMBER REPORTS

A. From the Council

Councilmembers had no reports.

B. From the Mayor

Mayor Backus had no report.

ADJOURNMENT

There being no further business to come before the Council, the meeting was adjourned at 8:33 p.m.

APPROVED this 5th day of May 2025.

_____	_____
NANCY BACKUS, MAYOR	Shawn Campbell, City Clerk

City Council
Special Meeting
April 14, 2025 - 5:00 PM
City Hall Council Chambers

MINUTES

CALL TO ORDER

Mayor Backus called the meeting to order at 7:00 p.m. in the Council Chambers of Auburn City Hall, 25 West Main Street.

LAND ACKNOWLEDGEMENT

Mayor Backus acknowledged the Federally Recognized Muckleshoot Indian Tribe as the ancestral keepers of the land we are gathered on today.

PUBLIC PARTICIPATION

The Special City Council Meeting was held in person and virtually.

PLEDGE OF ALLEGIANCE

Mayor Backus led those in attendance in the Pledge of Allegiance.

ROLL CALL

Councilmembers present: Deputy Mayor Cheryl Rakes, Hanan Amer, Kate Baldwin, Clinton Taylor, Tracy Taylor, and Yolanda Trout-Manuel.

Mayor Nancy Backus and the following staff members present included: City Attorney Jason Whalen, Human Resources and Risk Management Director Candis Martinson, Chief of Police Mark Caillier, and City Clerk Shawn Campbell.

AUDIENCE PARTICIPATION

No one came forward to speak.

COUNCIL VACANCY INTERVIEW

A. Candidate Interviews

Mayor Backus explained the voting and selection process that will occur after the interviews are complete.

City Clerk Campbell selected the applicants' names at random to determine the order of the interviews.

All candidates were asked to wait outside of Council Chambers and were escorted into Council Chambers when it was their turn to interview. Councilmembers asked all applicants the same questions, in the same order for each interview. The Council interviewed: Carmen Goers, Erica Tomas, Lisa Stirgus, Bill Steward, Adib Altallal, and John Holman.

EXECUTIVE SESSION

Mayor Backus adjourned into an Executive Session at 7:31 p.m. per RCW 42.30.110(1)(h) to evaluate the qualifications of a candidate for appointment to elective office. However, any interview of such candidate and final action appointing a candidate to elective office shall be in a meeting open to the public for 15 minutes. In addition to Mayor Backus, Councilmembers, and City Attorney Whalen were required to attend.

Mayor Backus extended the Executive Session by 15 minutes.
Mayor Backus extended the Executive Session by 20 minutes.
Mayor Backus extended the Executive Session by 5 minutes.

Mayor Backus reconvened the meeting at 8:32 p.m.

CANDIDATE SELECTION

A. Nomination and Voting for Candidate to Fill Unexpired Term

Mayor Backus thanked the candidates for their interest in the position and thanked Council and staff for their hard work throughout the entire process. She restated the voting process and asked Council for nominations.

Councilmember Amer nominated candidate John Holman.

Councilmember T. Taylor nominated candidate Lisa Stirgus.

Councilmember Baldwin nominated candidate Erica Tomas.

Councilmember Trout-Manuel nominated candidate Adib Altallal.

Councilmember C. Taylor moved and Deputy Mayor Rakes seconded for nominations to be closed.

MOTION CARRIED UNANIMOUSLY. 6-0

John Holman received one vote.

Lisa Stirgus received two votes.
Erica Tomas received one vote.
Adib Altallal received two votes.

Candidates Lisa Stirgus and Adib Altallal each received two votes. Councilmembers voted again for the two candidates that received the most votes.

Lisa Stirgus received four votes.
Adib Altallal received two votes.

By majority vote of the Council, Lisa Stirgus was selected to fill the Vacant Council Seat No. 6.

ADJOURNMENT

There being no further business to come before the Council, the meeting was adjourned at 8:45 p.m.

APPROVED this 5th day of May 2025.

_____	_____
NANCY BACKUS, MAYOR	Shawn Campbell, City Clerk

AGENDA BILL APPROVAL FORM

Agenda Subject:
Minutes from the April 21, 2025, Regular City Council Meeting

Meeting Date:
May 5, 2025

Department:
City Council

Attachments:
04-21-2025 Minutes

Budget Impact:

Administrative Recommendation:

Background for Motion:

Background Summary:

Councilmember:

Staff:

City Council
Regular Meeting
April 21, 2025 - 7:00 PM
City Hall Council Chambers

MINUTES

CALL TO ORDER

Mayor Backus called the meeting to order at 7:00 p.m. in the Council Chambers of Auburn City Hall, 25 West Main Street.

LAND ACKNOWLEDGEMENT

Mayor Backus acknowledged the Federally Recognized Muckleshoot Indian Tribe as the ancestral keepers of the land we are gathered on today.

PUBLIC PARTICIPATION

The City Council Meeting was held in person and virtually.

PLEDGE OF ALLEGIANCE

Mayor Backus led those in attendance in the Pledge of Allegiance.

ROLL CALL

Councilmembers present: Deputy Mayor Cheryl Rakes, Hanan Amer, Kate Baldwin, Lisa Stirgus, Clinton Taylor, Tracy Taylor, and Yolanda Trout-Manuel.

Mayor Nancy Backus and the following staff members present included: Senior City Staff Attorney Taryn Jones, Chief of Police Mark Caillier, Director of Community Development Jason Krum, Director of Public Works Ingrid Gaub, Director of Parks, Arts, and Recreation Julie Krueger, and Deputy City Clerk Rebecca Wood-Pollock.

ANNOUNCEMENTS, MAYOR'S PROCLAMATIONS, AND PRESENTATIONS

A. Earth Day

Mayor Backus proclaimed April 22, 2025, as "Earth Day" in the City of Auburn.

B. National Therapy Animal Day

Mayor Backus proclaimed April 30, 2025, as "National Therapy Animal Day" in the City of Auburn.

C. National Arab American Heritage Month

Mayor Backus proclaimed April 2025 as "National Arab American Heritage Month" in the City of Auburn.

D. Resolution 5812 Medic One/EMS Levy Presentation

Emergency Medical Services (EMS) Director Michele Plorde provided Council with a presentation on the Medic One/EMS Levy Planning Process regarding Resolution No. 5812, including an overview of the process, how the Medic One/EMS system works, Valley Regional Fire Authority (VRFA) statistics, population growth and response times, diversity, programs funded by the levy, an overview of the EMS Advisory Task Force and their recommendations, subcommittee recommendations, VRFA funding, revenues, expenditures and reserves, risk analysis, and a financial summary.

Council discussed average household costs for the levy.

AGENDA MODIFICATIONS

An updated PowerPoint presentation for Resolution No. 5812 was provided to the Mayor and Council.

AUDIENCE PARTICIPATION

Ron Morgan, Auburn
Ron discussed the King County Courthouse located in Auburn and expressed support for an Auburn Municipal Courthouse.

CORRESPONDENCE

There was no correspondence for Council to review.

COUNCIL AD HOC COMMITTEE REPORTS

A. Council Rules of Procedure

Councilmember Baldwin, Chair of the Council Rules of Procedure Ad Hoc Committee, reported that the Committee has another meeting scheduled for April 22, 2025, for further discussion on the Council Rules of Procedure.

CONSENT AGENDA

A. Setting the date for Public Hearing for Level 3 Communications, LLC Franchise Agreement

B. Claims Vouchers (Thomas)
Claims voucher list dated April 9, 2025 which includes voucher numbers

479399 through voucher 479440, and voucher numbers 479442 through voucher 479539 in the amount of $4,386,091.70, seventeen electronic fund transfers in the amount of $16,676.07 and four wire transfers in the amount of $810,582.72

C. Claims Vouchers (Thomas)
Claims voucher list dated April 9, 2025 which includes voucher number 479441 in the amount of $23,114.59

D. Payroll Voucher (Thomas)
Payroll check numbers 539666 through 539672 in the amount of $84,716.71, electronic deposit transmissions in the amount of $2,811,616.80, for a grand total of $2,896,333.51 for the period covering April 3, 2025 to April 16, 2025

Deputy Mayor Rakes moved and Councilmember C. Taylor seconded to approve the consent agenda.

MOTION CARRIED UNANIMOUSLY. 7-0

UNFINISHED BUSINESS

There was no unfinished business.

NEW BUSINESS

There was no new business.

RESOLUTIONS

A. Resolution No. 5812 (Mayor/Council)
A Resolution approving the placement of a Countywide Ballot Measure before voters in 2025 for a Funding Levy to support Medic One/Emergency Medical Services (EMS) for the period from January 1, 2026, through December 31, 2031, pursuant to RCW 84.52.069

Councilmember Baldwin moved and Councilmember Amer seconded to adopt Resolution No. 5812.

MOTION CARRIED UNANIMOUSLY. 7-0

Mayor asked for public comment in opposition to Resolution No.5812 ballot measure. No one came forward to speak.

B. Resolution No. 5819 (Gaub)
A Resolution designating the person serving in the position of the Sanitary Sewer Engineer and person serving in the position of the Utilities Engineering Manager as representatives to serve on the Metropolitan Water Pollution Abatement Advisory Committee

Councilmember T. Taylor moved and Deputy Mayor Rakes seconded to adopt Resolution No. 5819.

MOTION CARRIED UNANIMOUSLY. 7-0

C. Resolution No. 5822 (Gaub)
A Resolution authorizing the Mayor to execute and administer agreements accepting supplemental grant funds from the Washington State Department of Transportation and Federal Highway Administration for three projects: 1) Auburn Way S widening (Hemlock Street SE to Poplar Street SE); 2) 1st Street NE/NW and N Division Street pedestrian improvements; and 3) A Street SE preservation (37th Street SE to Lakeland Hills Way)

Councilmember T. Taylor moved and Councilmember Amer seconded to adopt Resolution No. 5822.

MOTION CARRIED UNANIMOUSLY. 7-0

D. Resolution No. 5823 (Krum)
A Resolution approving the Lodging Tax Grant disbursements recommended by the Auburn Lodging Tax Advisory Committee and authorizing the Mayor to execute agreements between the City of Auburn and Flight Club Foundation, the City of Auburn and Emerald Downs Racing LLC, and the City of Auburn Parks and Recreation Department for the purpose of tourism, marketing, and hotel rooms for Tourism Events

Councilmember T. Taylor moved and Councilmember Amer seconded to adopt Resolution No. 5823.

MOTION CARRIED UNANIMOUSLY. 7-0

E. Resolution No. 5824 (Gaub/Whalen)
A Resolution authorizing the Mayor to execute on behalf of the City, a Purchase and Sale Agreement for Commercial Property Owned by Wells Fargo Bank, N.A. at 105 1st Street NE (parcel no. 0483000050)

Councilmember T. Taylor moved and Councilmember Baldwin seconded to adopt Resolution No. 5824.

MOTION CARRIED UNANIMOUSLY. 7-0

MAYOR AND COUNCILMEMBER REPORTS

A. From the Council

Deputy Mayor Rakes reported she attended the Terry Home Auction, the Arbor Day tree planting ceremony, and the Postmark Center for the Arts Dedication and Open House event.

Councilmember Baldwin reported she attended the Auburn Lions Easter Egg

Hunt at the Les Gove Community Center.

Councilmember Stirgus reported she attended the Children's Dance Theater Grand Opening and the King County Children and Youth Advisory Board subcommittee meeting.

Councilmember T. Taylor reported she attended the Children's Dance Theater Grand Opening, the Terry Home Auction, and the Circle Creek Therapy grand opening.

Councilmember Trout-Manuel reported that she attended the Postmark Center for the Arts Dedication and Open House event.

B. From the Mayor

Mayor Backus reported she attended King County Regional Homelessness Board Authority retreat (KCRHA), the Children's Dance Theater Grand Opening, the Evergreen Parks Spring Back to School Free Haircuts Event, the Master Builders Association of King and Snohomish Counties quarterly meeting, the Mary Olson Farm tree planting ceremony, the Circle Creek Therapy Grand Opening, the Pierce County Homelessness Housing Authority meeting, South King Housing and Homeless Partners (SKHHP) monthly board meeting, the Bridges Neighborhood Easter Egg Hunt, and the Postmark Center for the Arts Dedication and Open House Event.

ADJOURNMENT

There being no further business to come before the Council, the meeting was adjourned at 8:08 p.m.

APPROVED this 5th day of May, 2025.

_____	_____
NANCY BACKUS, MAYOR	Rebecca Wood-Pollock, Deputy City Clerk

AGENDA BILL APPROVAL FORM

Agenda Subject:
Minutes from the April 28, 2025, Study Session Meeting

Meeting Date:
May 5, 2025

Department:
City Council

Attachments:
04-28-2025 Minutes

Budget Impact:

Administrative Recommendation:

Background for Motion:

Background Summary:

Councilmember:

Staff:

City Council
Study Session
Community Wellness SFA
April 28, 2025 - 5:30 PM
City Hall Council Chambers

MINUTES

CALL TO ORDER

Councilmember Yolanda Trout-Manuel called the meeting to order at 5:30 p.m. in the Council Chambers of Auburn City Hall, 25 West Main Street.

PUBLIC PARTICIPATION

The Study Session Meeting was held in person and virtually.

ROLL CALL

Councilmembers present: Hanan Amer, Kate Baldwin, Clinton Taylor, Tracy Taylor, and Yolanda Trout-Manuel. Deputy Mayor Cheryl Rakes and Councilmember Lisa Stirgus were excused.

Mayor Nancy Backus and the following staff members present included: City Attorney Jason Whalen, Chief of Police Mark Caillier, Patrol Commander Todd Byers, Inspectional Services Commander Shaun Feero, Director of Community Development Jason Krum, Director of Public Works Ingrid Gaub, Director of Human Services Kent Hay, Director of Finance Jamie Thomas, Community Development Block Grant Coordinator Jody Davison, Planning Services Manager Alexandria Teague, Planner II Gabriel Clark, and Deputy City Clerk Hannah Scholl.

AGENDA MODIFICATIONS

There were no modifications to the agenda.

ANNOUNCEMENTS, REPORTS, AND PRESENTATIONS

A. Police Department Annual Report (Caillier) (20 Minutes)

Chief Caillier and Commander Feero provided Council with a presentation on the 2024 Annual CIA Review including commendations, internal investigations, supervisory investigation, allegations, collisions, combined discipline, and outside agency investigations.

Council discussed CAD incidents, sustained versus unsustained misconduct, allegations, officer training, and the officer decertification process.

Chief Caillier and Commander Feero provided Council with a presentation on the 2024 Use of Force Report including contacts versus use of force, complaints, types of force, effective versus non-effective uses, injuries, incidents by time of day, and reasons for force. They also discussed resistance during force, officer assessments, and demographics.

Council discussed force types, reasons for force, and results of injury statistics.

Chief Caillier and Commander Byers provided Council with a presentation on the 2024 Pursuit Analysis including total number of pursuits, time of day statistics, reasons for pursuits, total miles driven for pursuits, Washington State Initiative No. 2113, and the Emergency Vehicle Operations Course (EVOC).

Council discussed pursuits outside of City limits, and training requirements.

Chief Caillier provided Council with an overview of the 2024 Annual Report Highlights including calls for service, felony investigations, person crimes, property crimes, response times, total arrests, and employee years of service.

Council discussed employee retention, recruitment, and the vehicle take-home program.

COMMUNITY WELLNESS DISCUSSION ITEMS

A. Consolidated Annual Performance Evaluation Report (CAPER) for 2024 (Hay) (20 Minutes)

Director Hay and Coordinator Davison provided Council with an overview of the Consolidated Annual Performance Evaluation Report (CAPER) including City funding support, goals, available funding, allocations of funds, people and population served by goals, demographic breakdown, sidewalk improvements, and the home repair program.

Council discussed people served, and funding.

B. Resolution No. 5825 (Hay) (20 Minutes)
A Resolution adopting the 2025-2029 Consolidated Plan and the 2025 Annual Action Plan

Director Hay, Director Krum, and Coordinator Davison provided Council with an overview of Resolution No. 5825, including the 2025-2029 Consolidated and Action Plan, public engagement, stakeholder engagement, feedback, needs

assessment, goals, key changes, funding, and next steps.

Council discussed funding and tenant improvements to the Auburn Resource Center (ARC).

AGENDA ITEMS FOR COUNCIL DISCUSSION

A. 4th Quarter 2024 Financial Report (Thomas) (20 Minutes)
Financial Report through December 2024

Director Thomas provided Council with an overview of the 4th Quarter 2024 Financial Report including General Fund Revenue, and Tax Revenues including: Property Tax, Retail Sales and Use Tax, Utility Tax, Business and Occupation Tax (B&O), and other taxes. She discussed Licenses and Permits, Intergovernmental, Charges for Services, Fines/Penalties, and Interest/Investment revenues. She also discussed General Fund Expenditures by Department, ARPA fund update, and Non-General Fund highlights.

Council discussed bonds.

B. Ordinance No. 6974 (Gaub) (10 Minutes)
An Ordinance granting to Level 3 Communications, LLC, a franchise for fiber optic telecommunications

Director Gaub provided Council with an overview of Ordinance No. 6974, including the Franchise Agreement with Level 3 Communications, LLC.

C. Ordinance No. 6978 (Krum) (30 Minutes)
An Ordinance relating to adoption of a temporary 6-month moratorium on the acceptance, processing, and/or approval of applications for Building and Land Use Development Permits and related Land Use Decisions for Energy Storage System Facilities proposed to be located within the City of Auburn

Planner Clark provided Council with an overview of Ordinance No. 6978, including Battery Energy Storage Systems (BESS), Lithium-Ion Batteries, residential versus commercial and grid, primary functions, flow map of systems, impacts, demand, and the reason for the Moratorium. He also discussed the jurisdictional responses, standards, and the proposed timeline.

Council discussed infrastructure, the Burlington Northern Santa Fe (BNSF) Railway, environmental impacts, and backup cooling systems.

ADJOURNMENT

Councilmember T. Taylor asked for a status update on the Council Rules and Procedure Ad Hoc Committee. Councilmember Baldwin shared that the Ad Hoc Committee is still reviewing and have their next meeting on May 8, 2025.

There being no further business to come before the Council, the meeting was adjourned at 8:17 p.m.

APPROVED this 5th day of May 2025.

_____	_____
CHERYL RAKES, DEPUTY MAYOR	Hannah Scholl, Deputy City Clerk

AGENDA BILL APPROVAL FORM

Agenda Subject:
Claims Vouchers (Thomas)
Claims voucher list dated April 23, 2025, which includes voucher numbers 479540 through voucher 479696, in the amount of $2,277,895.89, nine electronic fund transfers in the amount of $18,186.08, and four wire transfers in the amount of $878,679.34

Meeting Date:
May 5, 2025

Department:
Finance

Attachments:
None

Budget Impact:

Administrative Recommendation:
City Council to approve Claim Vouchers.

Background for Motion:

Background Summary:
Claims voucher list dated April 23, 2025, which includes voucher numbers 479540 through voucher 479696, in the amount of $2,277,895.89, nine electronic fund transfers in the amount of $18,186.08, and four wire transfers in the amount of $878,679.34.

Councilmember: Kate Baldwin

Staff: Jamie Thomas

AGENDA BILL APPROVAL FORM

Agenda Subject:
Payroll Voucher (Thomas)
Payroll check numbers 539673 through 539678 in the amount of $692,244.77, electronic deposit transmissions in the amount of $2,604,065.33, for a grand total of $3,296,310.10 for the period covering April 17, 2025, to April 30, 2025

Meeting Date:
May 5, 2025

(RECOMMENDED ACTION: Move to approve the Consent Agenda.)

Department:
Finance

Attachments:
None

Budget Impact:

Administrative Recommendation:
City Council to approve Payroll Vouchers.

Background for Motion:

Background Summary:
Payroll check numbers 539673 through 539678 in the amount of $692,244.77, electronic deposit transmissions in the amount of $2,604,065.33, for a grand total of $3,296,310.10 for the period covering April 17, 2025, to April 30, 2025.

Councilmember: Kate Baldwin

Staff: Jamie Thomas

AGENDA BILL APPROVAL FORM

Agenda Subject:
Ordinance No. 6978 (Krum)
An Ordinance relating to adoption of a temporary 6-month moratorium on the acceptance, processing, and/or approval of applications for Building and Land Use Development Permits and related Land Use Decisions for Energy Storage System Facilities proposed to be located within the City of Auburn

Meeting Date:
May 5, 2025

(RECOMMENDED ACTION: Move to approve Ordinance No. 6978.)

Department:
Community Development

Attachments:
Ordinance No. 6978, Exhibit A BESS Moratorium PowerPoint, Exhibit B Greening the Grid, US-AID, Exhibit C VRFA Response to BESS Incident, Exhibit D Canyon County Commission Incident Response Report, Exhibit E City of Covington Moratorium, Exhibit F SB 1216 Clean Energy Sitin Coordinating Council, Exhibit G Comprehensive Review of Energy Storage Systems, Exhibit H PSE Siting Scores, Exhibit I PSE Service Area Map

Budget Impact:

Administrative Recommendation:
City Council to approve Ordinance No. 6978.

Background for Motion:
This Ordinance will impose a temporary 6-month moratorium on permitting activity related to commercial Energy Storage Systems facilities to allow City Staff to develop appropriate zoning, development, and construction regulations for these types of systems.

Background Summary:
On April 28, 2025, staff identified the following unknown risks and economic factors that may be relevant in assessing the desirability of, and siting concerns associated with, ESS in the City to the City Council at Study Session. The City currently does not have specific zoning or development standards applicable to these projects. ESS can be facilities store excess electricity when demand on

the grid is low and can discharge back into the grid when demand for electricity is high, or electrical energy production is low (Exhibit B).

Battery or electrochemical (BESS) energy storage systems primarily contain lithium-ion batteries due to their availability, capacity, efficiency, and general reliability (Exhibit G). Thermal runaway presents a significant burden to emergency personnel as fires may burn for an inordinate amount of time, release toxic gasses, or explode. An incident may require a regional response, potentially depleting resources and leaving other areas of the city vulnerable to high response times.

If battery cell(s) combust, a report (Exhibit C) from Valley Regional Fire Authority (VRFA) indicated a multi-shift would be required to manage the emergency. As a result, VRFA and other first responders present would continuously pour water into the compromised battery area; this cool water would regulate the heat and aid to prevent other cells from becoming compromised. Water used to cool the compromised cells will become contaminated with hazardous materials within the battery. If the contaminated water is not properly contained, it may leach into the City's stormwater system or critical areas. It is unknown if the local water district, or City could support the water demand for a period of 12 or more hours in the event of an emergency.

In the event of an emergency, the impacts to regional transportation routes, businesses, and residents are unknown if an evacuation zone is established as a hazard mitigation plan may need to be established.

Separately from an emergent response, it is not known what the operational impacts a BESS facility may have. These impacts include, but are not limited to, visual, noise, habitat, airport glare, land use or long-term ecological impacts resulting from decommissioning of the aged lithium-ion batteries.

Presently, land use code is not clear the compatibility of a BESS facility with the land use category of "Utility facilities and substations" in ACC 18.07.030 and "Utility transmission or distribution line or substation" in ACC 18.23.030. These uses are not intended to include recent technological changes and business models in Energy Storage Systems or supporting infrastructure. "Utility Facilities and Substations" are intended to include public utilities with marginal impacts to the surrounding community, environment, and services.

BESS facilities are much larger than a local or regional substation, can be privately developed and leased to a public utility. While BESS are becoming more popular as a source of reliable energy storage and relief, jurisdictions across the region are developing standards to help manage the siting, construction, and operation of these facilities (Exhibit E). The proposed moratorium under Ordinance No. 6978 prevents development for a finite amount of time as the City studies the impacts and develops regulatory language for siting, construction, and operation.

The Washington State Department of Ecology has initiated studies into BESS and is working to provide guidance on how BESS may impact the surrounding environment. The City wishes to study the results of Ecology's efforts before updating its zoning and other regulations applicable to ESS facilities. The Washington State Legislature adopted House Bill 1216 in 2023 (Exhibit F) which established the Interagency Clean Energy Siting Coordinating Council to identify actions to improve siting and permitting clean energy projects within the State.

It is unknown what fiscal or economic development benefits would flow to the City if ESS facilities were permitted within the City, or which zone(s) would be suitable for siting them. The City needs to investigate and analyze potential economic impacts and tax revenues associated with such projects.

Councilmember: Tracy Taylor **Staff:** Jason Krum

ORDINANCE NO. 6978

AN ORDINANCE OF THE CITY COUNCIL OF THE CITY OF AUBURN, WASHINGTON, RELATING TO ADOPTION OF A TEMPORARY 6-MONTH MORATORIUM ON THE ACCEPTANCE, PROCESSING, AND/OR APPROVAL OF APPLICATIONS FOR BUILDING AND LAND USE DEVELOPMENT PERMITS AND RELATED LAND USE DECISIONS FOR ENERGY STORAGE SYSTEM FACILITIES PROPOSED TO BE LOCATED WITHIN THE CITY OF AUBURN

WHEREAS, Energy Storage Systems (ESS) including Battery Energy Storage Systems (BESS) are defined as installations designed to store critical electrical energy for later use, typically consisting of batteries, power conversion systems, and control equipment, a primary function of Energy Storage Systems is to store excess electricity generated by the grid during periods of low demand or high renewable energy production, such as from solar or wind sources, the stored energy can then be discharged when demand is high or when renewable energy generation is low, stabilizing the electrical grid and improving overall efficiency and reliability;

WHEREAS, the City's development regulations, specifically the land use category of "Utility facilities and substations" in ACC 18.07.030 and "Utility transmission or distribution line or substation" in ACC 18.23.030, are not currently defined to include the recent technological changes and business models in Energy Storage Systems or supporting infrastructure;

WHEREAS, the City's development regulations, specifically the land use category of "Utility facilities and substations" in ACC 18.07.030 and "Utility transmission or

distribution line or substation" in ACC 18.23.030, are understood to include public regional utility (PSE) agencies that provide public services such as transformers, substations, pumpstations and smaller scale grid infrastructure;

WHEREAS, ESS are primarily financed and constructed by private corporations and leased to energy utilities for maintenance and operation;

WHEREAS, applying the current regulations in Title 18 ACC to new technologies and business models could lead to approval of ESS projects that are undesirable, unsafe, and/or inconsistent with long-term planning goals and objectives of the City, particularly when the existing regulations have not been reviewed and updated for the best practices nor reconsidered in light of technological changes and potential impacts ESS facilities have on the surrounding areas and community resources;

WHEREAS, thermal runaway is a primary risk related to lithium-ion batteries, a phenomenon in which lithium-ion cells enter an uncontrollable, self-heating state, resulting in ejection of gas, shrapnel, and/or particulates, extremely high temperatures, smoke, and fire;

WHEREAS, the Auburn City Council makes the following findings of fact in support of a moratorium under RCW 36. 70A.390, and identified the following unknown risks and economic factors, that may be relevant in assessing the desirability of, and siting concerns associated with, ESS in the City:

A. The City currently does not have specific zoning or development standards applicable to ESS;

B. ESS can be facilities of any type that store electrical energy in potential

kinetic energy, mechanical energy or electrochemical energy when demand on the grid is low and can discharge back into the grid when demand for electricity is high, or electrical energy production is low;

C. In the instance of electrochemical or battery energy storage systems (BESS), lithium-ion batteries are commonly used due to their availability, capacity, efficiency, and general reliability, the chemical composition of lithium-ion batteries may pose increased risk to life and property in the event of thermal runaway or gaseous vapors being released during an emergency;

D. Thermal runaway at a BESS presents a significant burden to emergency personnel as fires may burn for an inordinate amount of time, requiring increased lengths for monitoring and containment, leaving other areas of the City vulnerable due to longer response times;

E. Exceptional amounts of water is required in the event of a thermal runaway to protect other cells from reaching a critical temperature and to suppress the compromised cell, the water used to control the emergency may contain hazardous chemicals and materials such as cyanide and hydrofluoric acid that may leach into the City's protected critical areas identified in Chapter 16.10 ACC;

F. Due to the exceptional amounts of water required to suppress a thermal event, it is not known if the City, or the surrounding water districts have the capacity to provide a constant flow of high-volume water;

G. BESS may create potentially hazardous air quality concerns in the event of an emergency;

H. In the event of an emergency, the response may pose a strain on the first responder personnel that is not fully understood;

I. In the event of an emergency, it is unknown what the impacts to regional transportation routes, businesses, and residents if an evacuation zone is established;

J. ESS may produce noise and visual impacts that are not currently well understood;

K. ESS may produce impacts to wildlife that are not currently well understood;

L. ESS facilities located within the L-F Airport Landing Field District may pose a significant risk to public health, safety, and welfare if an aircraft collision occurs;

M. ESS facilities and their supporting infrastructure may be more appropriate for the industrial (M-1 and M-2) zones in the City due to their scale, land use, and potential impacts to life and safety of the general public;

N. The Washington State Department of Ecology has initiated studies into ESS and is working to provide guidance on how ESS may impact the surrounding environment, and the City wishes to study the results of Ecology's efforts before updating its zoning and other regulations applicable to ESS facilities;

O. The Washington State Legislature adopted House Bill 1216 in 2023 which established the Interagency Clean Energy Siting Coordinating Council to

identify actions to improve siting and permitting of clean energy projects within the State;

P. Puget Sound Energy (PSE), hired PSC (Power Systems Consultants) to conduct an Energy Storage System Location Study detailing locations of potential BESS facilities connected via high-voltage transmission lines to PSE's regional substations, siting (Exhibit H) the Christopher Substation for initial low risk ESS interconnection;

Q. It is unknown what fiscal or economic development benefits would be realized by the City if ESS facilities were permitted within the City or which zone(s) would be suitable for siting them. Further investigation and analysis of the potential economic impacts and tax revenues associated with such projects is warranted;

R. The City does not currently have ESS facilities or locations incorporated or accounted for in an emergency management response plan. ESS present unique emergency management needs that require coordination between the City, its departments, and outside entities;

WHEREAS, the unique characteristics of ESS facilities, certain existing requirements in Code may not be appropriately address or mitigate the community impacts and risks such facilities may present;

WHEREAS, the City Council held a public hearing on 7:00 PM on May 5, 2025, and is adopting the findings contained herein after the conclusion of said public hearing;

WHEREAS, to promote public health, safety, and welfare, the City Council deems

it necessary and proper to impose a moratorium on land use and development permit applications related to ESS for a period of six (6) months;

WHEREAS, processing applications for land use approvals, development permits, and related applications or code interrelations for ESS facilities under exciting zoning code regulations and other official controls could potentially result in approvals of undesirable and incompatible development until such time that the City has properly reviewed its regulations and implemented any zoning code revisions or additional controls deemed necessary and proper for the health, safety, and general welfare of the City and its residents;

WHEREAS, it would be an efficient use of resources and an appropriate exercise of its planning authority under the Growth Management Act and Chapter 35A.63 RCW for the City to analyze whether, and under what regulatory parameters, ESS Energy Storage Systems should be allowed uses within the City;

WHEREAS, the City possesses land use jurisdiction and regulatory authority over the City's incorporated lands;

WHEREAS, the adoption of this moratorium is exempt from the threshold determination requirements under the State Environmental Policy Act;

WHEREAS, the potential adverse impacts on public health, property, safety, and welfare of the City and its citizens if this moratorium does not take effect immediately, further justifies a moratorium under RCW 36.70A.410 and the designation of this ordinance as necessary for the protection of public health, public property, or the public peace by the Council, the moratorium imposed herein promotes the public good and is

necessary for the protection of public health, property, safety, and welfare; and

NOW THEREFORE, THE CITY COUNCIL OF THE CITY OF AUBURN, WASHINGTON, DO ORDAIN AS FOLLOWS:

Section 1. Findings of Fact.

The recitals set forth above as well as Exhibits A through I are hereby adopted as the City Council's findings of fact in support of the moratorium established by this ordinance.

Section 2. Moratorium Imposed.

Pursuant to RCW 35A.63.220, and RCW 36.70A.390, a temporary moratorium is hereby imposed upon Tier II and Tier III ESS facilities in any zone within the City of Auburn. This moratorium also applies to the City's acceptance, processing, or approval of any applications, building permits, and land use permits for ESS facilities including without limitation;

A. Administrative Use permits;

B. Conditional Use permits;

C. Building permits;

D. Grading permits;

E. Short plats;

F. Subdivisions;

G. Binding site plans;

H. Reasonable use exceptions;

I. Variances from Title 18 ACC regulations;

J. Deviations from any City of Auburn engineering design and construction standards or other technical codes for ESS facility within the City or any other type of development permit, approval, or code interpretation in connection with the same; and

K. Any other development permits related to ESS facilities.

The moratorium codified herein shall not apply to Tier I residential Battery Energy Storage Systems that serve as a back-up source of energy, load shedding, and storage of solar energy. Fires and other emergencies typically seen from Tier I BESS are limited in their impacts to the safety, welling, and health of Citizens.

Section 3. Term of Moratorium.

The moratorium imposed by this Ordinance shall become effective on the date described in Section 8, and shall continue in effect for an initial period of six (6) months, unless repealed, extended or modified by the City Council after subsequent public hearing(s) and entry of appropriate findings of fact pursuant to RCW 35A.63.220, provided that the moratorium shall automatically expire upon the effective date of zoning and land use regulations adopted by City Council to address siting, construction, and operation of ESS located within the City of Auburn.

Section 4. Public Hearing.

Pursuant to RCW 35A.63.220 and RCW 36.70A.390, the City Council has held a public hearing at the City Council's regular meeting at 7:00 PM on May 5, 2025, in order to take public testimony on this moratorium.

Section 5. Severability, Constitutionality and Invalidity.

If any section, subsection sentence, clause, finding, phrase, or portion of this Ordinance, is for any reason held invalid or unconstitutional by any Court of competent jurisdiction such portion shall be deemed a separate, distinct and independent provision, and such holding shall not affect the validity of the remaining portions thereof.

Section 6. Corrections.

Upon the approval of the City Attorney the City Clerk and the codifiers of this ordinance are authorized to make any necessary corrections to this ordinance including, but not limited to, the correction of scrivener's/clerical errors, references, ordinance numbering, section/subsection numbers, and any reference thereto.

Section 7. Implementation. The Mayor is authorized to implement such administrative procedures as may be necessary to carry out the directions of this legislation.

Section 8. Effective Date.

This Ordinance shall take effect and be in force five (5) days from and after its passage, approval and publication as provided by law.

<u>Section 9.</u> Ordinance Transmitted to State.

Pursuant to RCW 36.70A.106, a copy of this ordinance shall be transmitted to the Washington State Department of Commerce.

INTRODUCED: _____

PASSED: _____

APPROVED: _____

_____
NANCY BACKUS, MAYOR

ATTEST:

_____
Shawn Campbell, MMC, City Clerk

APPROVED AS TO FORM:

_____
Jason Whalen, City Attorney

Published: _____

COUNCIL STUDY SESSION

ENERGY STORAGE SYSTEM MORATORIUM ORDINANCE NO. 6978

PRESENTED BY
GABRIEL CLARK, PLANNER II
APRIL 28, 2025

Department of Community Development
Planning • Building • Development Engineering • Permit Center
Economic Development • Code Enforcement

AUBURN VALUES

SERVICE
ENVIRONMENT
ECONOMY
CHARACTER
SUSTAINABILITY
WELLNESS
CELEBRATION

WHAT ARE ENERGY STORAGE SYSTEMS?

- Energy Storage Systems (ESS) vary widely in their uses and installation types; their primary function is to store electrical energy during periods of low demand and discharge at periods of high demand.
  - Battery Energy Storage Systems (BESS) are a type of ESS which uses battery technology to provide storage and improve the overall stability of the electrical grid.

- Other functions include:
  - Load Shedding
  - Load Sharing
  - Smoothing and dispatching from renewable energy sources
  - Emergency power storage

- **<u>The moratorium covers all ESS, BESS is the primary concern for Staff.</u>**

WHY A LITHIUM-ION BATTERY?

- Lithium-ion batteries are a very common method of storing electrical energy for usage and may be charged and discharged reliably.
- Examples:
  - Phone batteries
  - Laptop computers
  - Electric Vehicles

WHAT ARE THE DIFFERENT TYPES?

Residential

Moratorium

Commercial

Grid

PRIMARY FUNCTIONS VISUALIZED

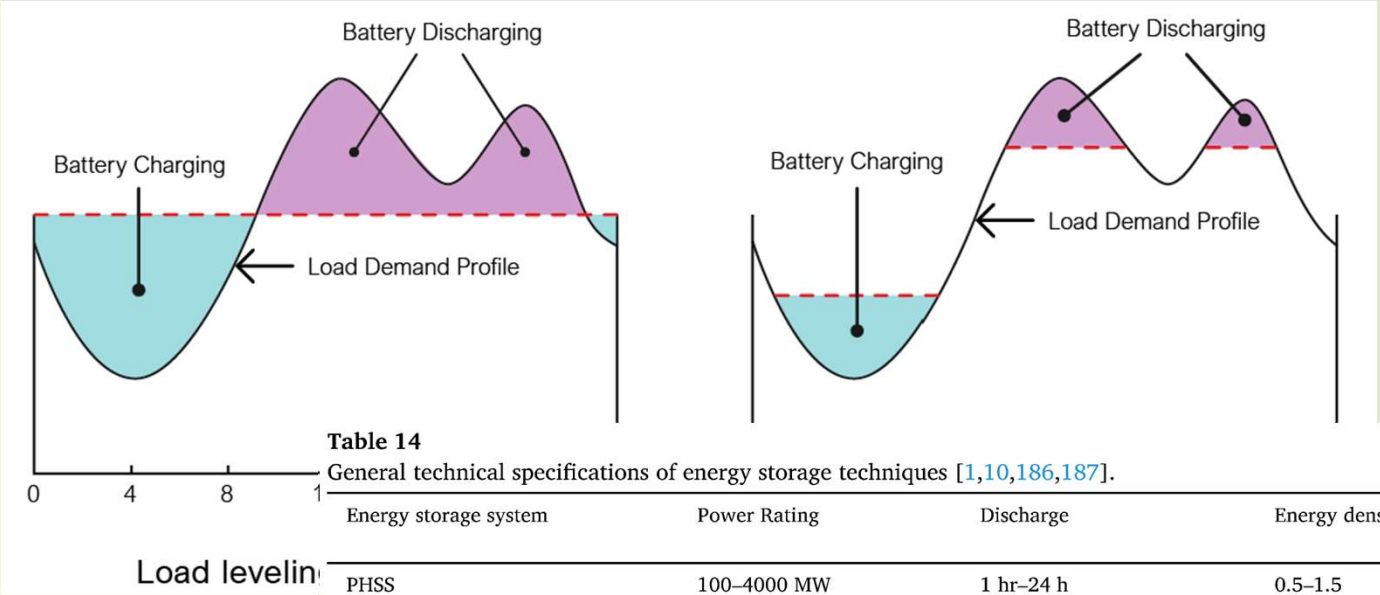
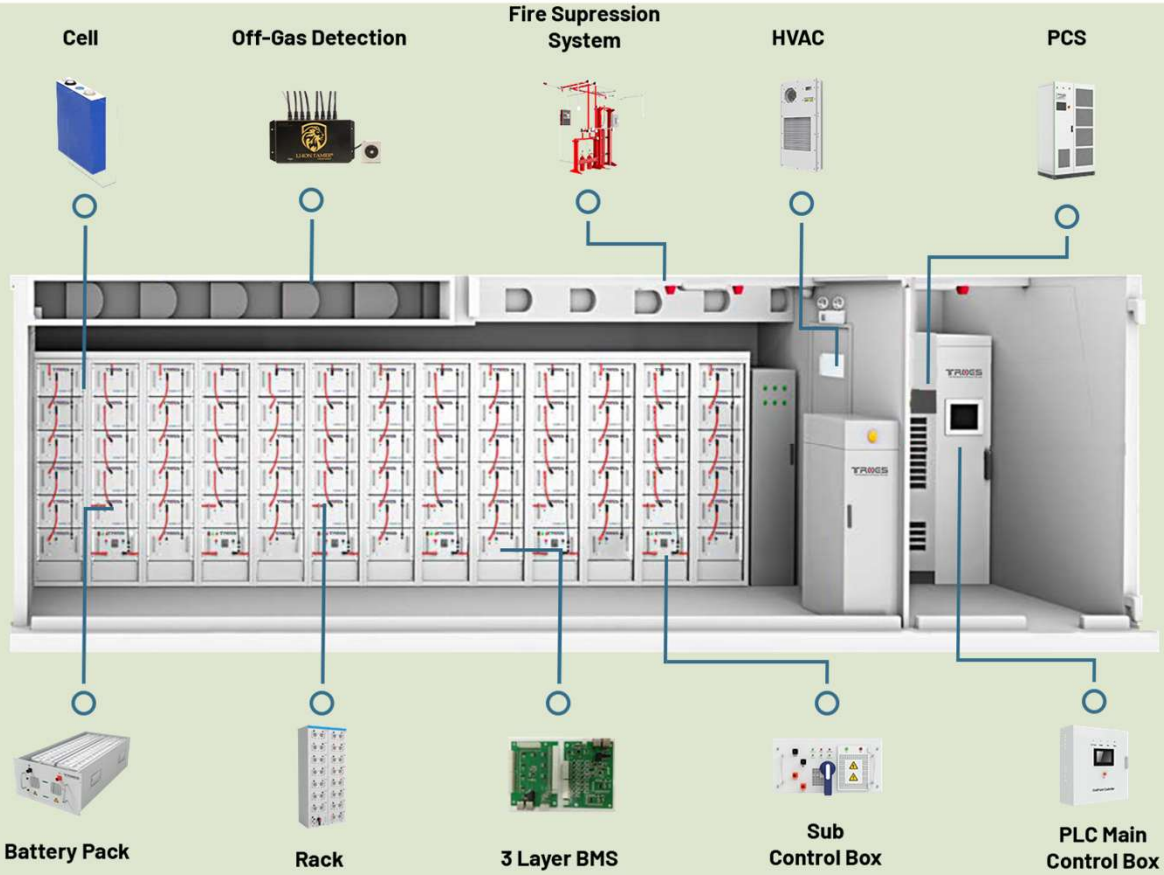


Table 14
General technical specifications of energy storage techniques [1,10,186,187].

Energy storage system	Power Rating	Discharge	Energy density Wh/kg	Energy cost €/KWh	Lifetime Efficiency
PHSS	100–4000 MW	1 hr–24 h	0.5–1.5	50–150	70–85 %
FES	0.002–20 MW	msec to 40 Min	5–130	1000–3500	90–95 %
CAES	50–300 MW	1he- 24 h	30–60	10–120	70–80 %
Ni-CD	0.001–0.1 MW	0.0003–1 h	40–60	200–1000	60–91 %
Li-ion	0.001–0.1 MW	0.0167–1 h	75–250	200–1800	85–100 %
Nas	0.5–50 MW	0.0003–2 h	150–240	200–900	85–90 %
Hydrogen	0.001–50 MW	14 hr- 24 h	800–10000	1–15	20–50 %
Supercapacitor	0.01–1 MW	msec to minute	0.1–15	300–4000	90-95ˆ
SMES	10 kW-10MW	msec to seconds	0.5–5	700–7000	80–90 %

FLOW MAP OF TIER II AND III SYSTEMS

CROSS SECTION OF A BESS CABINET



WHAT ARE THE IMPACTS OF BESS SYSTEMS?

- **Primary Impact: Thermal Runaway**

NEWS

California moves to impose more control over BESS in wake of Moss Landing fire

By April Bonner

March 5, 2025

US & Canada, Americas | Grid Scale | Policy

LinkedIn | Twitter | Reddit | Facebook | Email

Aerial view of the Moss Landing site, including the Vistra natural gas plant which the site is historically better known for. Image: LG Energy Solution.

In the wake of the Moss Landing Energy Storage Facility fire, regional and state-wide California authorities have proposed or passed legislation tightening control of BESS projects.

On the afternoon of 16 January 2025, a fire broke out at Moss Landing Energy Storage Facility in Monterey County, California, US, prompting the evacuation of 1,200 to 1,500 local residents.

m lead-acid batte
y. Lithium-ion ba
power banks.

they are also ve
en they catch fire,

monly used beca
al Fire Protection
nner, it generates
s can pose a fire

Site safety measures help limit spread of fire at 600 MWh BESS in England

It took 24 hours for the firefighters to tackle the blaze at Statera's 300 MW/600 MW

ex

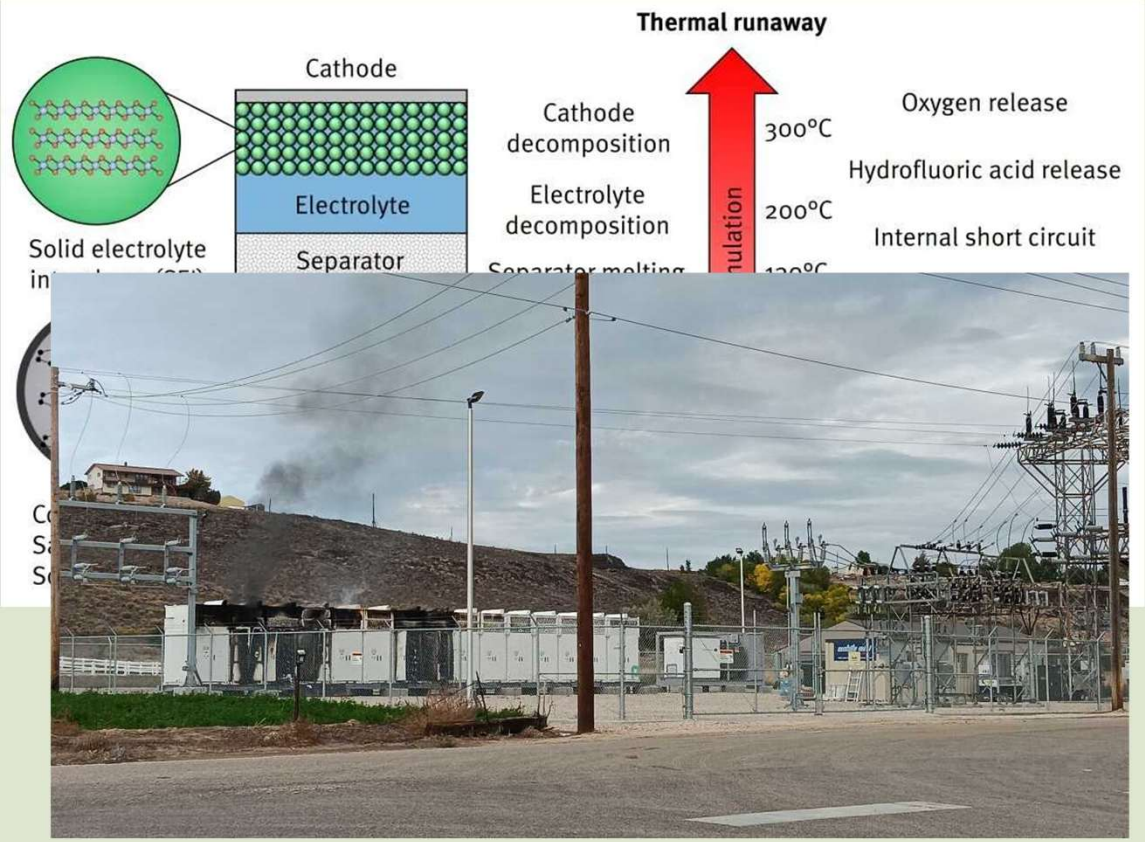
S) close to

the fire in
s and
drones, to monitor temperatures and manage the fire in a controlled manner, and water to prevent heat transfer. The crews handed the scene over to the site management on the next day.

WHAT IS THE CAUSE OF THESE FIRES?

- Thermal Runaway:
  - "A primary risk related to Lithium-ion batteries. It is a phenomenon in which the Lithium-ion cell enters an uncontrollable, self-heating state." – UL Research Institutes

- To reduce the likelihood of thermal runaway, the batteries need to be isolated, cooled, and monitored.



WHAT IS THE DEMAND?

- PSE Hired Power Systems Consultants to report the most viable sites in the service area.
  - Christopher Substitution cited as “low risk”
- Puget Sound Energy announcing two BESS projects in the State.
  - Appaloosa Solar Project (Garfield County)
  - Greenwater BESS Project (Sumner)

JU8426 – PSC Report for Puget Sound Energy ESS Locations

3.1.1. Candidate Stations

Table 3.1 lists the 20 PSE stations that were analyzed in detail. These stations were visually inspected with recent overhead imagery and are organized by color for low risk and medium risk substations. As previously stated, the substation configuration metrics were not used for the initial candidate stations and will be addressed later in the report. Substations that are of a main bus configuration are highlighted in red.

Table 3.1 Qualitative Results for Low Risk (Green) and Medium Risk (Yellow) Stations

Puget Sound Energy adds two new clean energy projects in Washington

The new projects will add almost 350 MW of clean energy from utility scale solar and battery energy storage

BELLEVUE, Wash. (9/24/2024) Puget Sound Energy (PSE) is proud to announce two large projects in Washington state that will help add more clean energy to its portfolio.

The first is the development of a utility-scale solar facility known as Appaloosa Solar Project that PSE will own and operate. The second is a power purchase agreement signed with BrightNight for a Battery Energy Storage System (BESS) known as the Greenwater project.

Together, the projects can generate up to 342 MW of energy to help PSE's commitment to diversify its renewable resource mix and meet the state's Clean Energy Transformation Act (CETA) targets.

Since the passage of CETA in 2019, PSE has added more than 3,800 MW of renewable energy resources to its resource mix. More than half (2,033 MW) of that comes from new resources from 11 projects built to serve the energy needs of our customers.

WHAT IS THE REASON FOR THE MORATORIUM?

- Tier I (residential) BESS installations have limited negative impacts and will not be considered under this moratorium.
- Tier II and Tier III facilities may pose impacts to the safety, well-being and health to the residents and business in Auburn.
- The moratorium will provide needed time for the City to research these impacts and develop regulatory standards.
- **Community Development and Public Works need to develop effective siting, construction, and operation regulations.**

WHAT IS THE JURISDICTIONAL RESPONSE?

- Meetings with Valley Regional Fire Authority (VRFA) concluded the main method of extinguishing fires at BESS facilities is to continually douse the compromised rack with cool water.
- VRFA would be required to post several units at the site, for a multi shift response (12+ hours) and treated as a hazardous materials response.
- A fire would require a significant response. VRFA, Auburn Police, Department of Ecology, Puget Sound Clean Air Agency and other agencies.
- Community Development Staff are developing a new chapter in Title 18 to facilitate the siting, construction, and operation of BESS projects.

WHAT STANDARDS?

Existing

- International Fire Code (IFC) and National Fire Protection Association (NFPA)
  - Chapter 12 of the Washington State IFC (Est. March 2024)
  - 2023 edition of the NFPA 855 Standard Installation of Stationary Energy Storage Systems
- International Building Code (IBC) siting and construction standards.

Absent

- Comprehensive guidance on siting, construction, and operation of ESS facilities.
  - Title 18 Zoning for siting and operation.
  - Engineering Design Standards (EDS)

PROPOSED TIMELINE

May	• Adopt Moratorium
Jun	• Research and program development
Jul	• Prepare zoning text amendment
Aug	• Present proposed text amendment to planning commission
Sep	• Present proposed text amendment to City Council
Oct	• Adopt amended code and moratorium expires

Department of Community Development

Planning • Building • Development Engineering • Permit Center
Economic Development • Code Enforcement

AUBURN VALUES

SERVICE

ENVIRONMENT

ECONOMY

CHARACTER

SUSTAINABILITY

WELLNESS

CELEBRATION

Grid-Scale Battery Storage

Frequently Asked Questions

What is grid-scale battery storage?

Battery storage is a technology that enables power system operators and utilities to store energy for later use. A battery energy storage system (BESS) is an electrochemical device that charges (or collects energy) from the grid or a power plant and then discharges that energy at a later time to provide electricity or other grid services when needed. Several battery chemistries are available or under investigation for grid-scale applications, including lithium-ion, lead-acid, redox flow, and molten salt (including sodium-based chemistries).[1] Battery chemistries differ in key technical characteristics (see *What are key characteristics of battery storage systems?*), and each battery has unique advantages and disadvantages. The current market for grid-scale battery storage in the United States and globally is dominated by lithium-ion chemistries (Figure 1). Due to technological innovations and improved manufacturing capacity, lithium-ion chemistries have experienced a steep price decline of over 70% from 2010-2016, and prices are projected to decline further (Curry 2017).

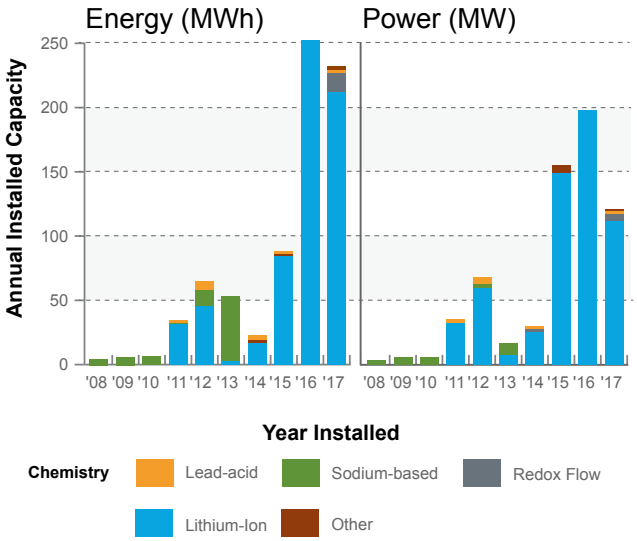


Figure 1: U.S. utility-scale battery storage capacity by chemistry (2008-2017). *Data source: U.S. Energy Information Administration, Form EIA-860, Annual Electric Generator Report*

Increasing needs for system flexibility, combined with rapid decreases in the costs of battery technology, have enabled BESS to play an increasing role in the power system in recent years. As prices for BESS continue to decline and the need for system flexibility increases with wind and solar deployment, more policymakers, regulators, and utilities are seeking to develop policies to jump-start BESS deployment.

Is grid-scale battery storage needed for renewable energy integration?

Battery storage is one of several technology options that can enhance power system flexibility and enable high levels of renewable energy integration. Studies and real-world experience have demonstrated that interconnected power systems can safely and reliably integrate high levels of renewable energy from variable renewable energy (VRE) sources without new energy storage resources.[2] There is no rule-of-thumb for how much battery storage is needed to integrate high levels of renewable energy. Instead, the appropriate amount of grid-scale battery storage depends on system-specific characteristics, including:

- The current and planned mix of generation technologies
- Flexibility in existing generation sources
- Interconnections with neighboring power systems
- The hourly, daily, and seasonal profile of electricity demand, and
- The hourly, daily, and seasonal profile of current and planned VRE.

In many systems, battery storage may not be the most economic resource to help integrate renewable energy, and other sources of system flexibility can be explored. Additional sources of system flexibility include, among others, building additional pumped-hydro storage or transmission, increasing conventional generation flexibility, and changing operating procedures (Cochran et al. 2014).

1. For information on battery chemistries and their relative advantages, see Akhil et al. (2013) and Kim et al. (2018).
2. For example, Lew et al. (2013) found that the United States portion of the Western Interconnection could achieve a 33% penetration of wind and solar without additional storage resources. Palchak et al. (2017) found that India could incorporate 160 GW of wind and solar (reaching an annual renewable penetration of 22% of system load) without additional storage resources.

What are the key characteristics of battery storage systems?

- **Rated power capacity** is the total possible instantaneous discharge capability (in kilowatts [kW] or megawatts [MW]) of the BESS, or the maximum rate of discharge that the BESS can achieve, starting from a fully charged state.
- **Energy capacity** is the maximum amount of stored energy (in kilowatt-hours [kWh] or megawatt-hours [MWh])
- **Storage duration** is the amount of time storage can discharge at its power capacity before depleting its energy capacity. For example, a battery with 1 MW of power capacity and 4 MWh of usable energy capacity will have a storage duration of four hours.
- **Cycle life/lifetime** is the amount of time or cycles a battery storage system can provide regular charging and discharging before failure or significant degradation.
- **Self-discharge** occurs when the stored charge (or energy) of the battery is reduced through internal chemical reactions, or without being discharged to perform work for the grid or a customer. Self-discharge, expressed as a percentage of charge lost over a certain period, reduces the amount of energy available for discharge and is an important parameter to consider in batteries intended for longer-duration applications.
- **State of charge,** expressed as a percentage, represents the battery's present level of charge and ranges from completely discharged to fully charged. The state of charge influences a battery's ability to provide energy or ancillary services to the grid at any given time.
- **Round-trip efficiency**, measured as a percentage, is a ratio of the energy charged to the battery to the energy discharged from the battery. It can represent the total DC-DC or AC-AC efficiency of the battery system, including losses from self-discharge and other electrical losses. Although battery manufacturers often refer to the DC-DC efficiency, AC-AC efficiency is typically more important to utilities, as they only see the battery's charging and discharging from the point of interconnection to the power system, which uses AC (Denholm 2019).

What services can batteries provide?

Arbitrage: Arbitrage involves charging the battery when energy prices are low and discharging during more expensive peak hours. For the BESS operator, this practice can provide a source of income by taking advantage of electricity prices that may vary throughout the day. One extension of the energy arbitrage service is **reducing renewable energy curtailment**. System operators and project developers have an interest in using as much low-cost, emissions-free renewable energy generation as possible; however, in systems with a growing share of VRE, limited flexibility of conventional generators and temporal mismatches between renewable energy supply and electricity demand (e.g., excess wind generation in the middle of the night) may require renewable generators to curtail their output. By charging the battery with low-cost energy during periods of excess renewable generation and discharging during periods of high demand, BESS can both reduce renewable energy curtailment and maximize the value of the energy developers can sell to the market. Another extension of arbitrage in power systems without electricity markets is **load-leveling**. With load-levelling, system operators charge batteries during periods of excess generation and discharge batteries during periods of excess demand to more efficiently coordinate the dispatch of generating resources.

Firm Capacity or Peaking Capacity: System operators must ensure they have an adequate supply of generation capacity to reliably meet demand during the highest-demand periods in a given year, or the peak demand. This peak demand is typically met with higher-cost generators, such as gas plants; however, depending on the shape of the load curve, BESS can also be used to ensure adequate peaking generation capacity. While VRE resources can also be used to meet this requirement, these resources do not typically fully count toward firm capacity, as their generation relies on the availability of fluctuating resources and may not always coincide with peak demand. But system operators can improve VRE's ability to contribute to firm capacity requirements through pairing with BESS. Pairing VRE resources with BESS can enable these resources to shift their generation to be coincident with peak demand, improving their capacity value (see text box below) and system reliability.

Firm Capacity, Capacity Credit, and Capacity Value are important concepts for understanding the potential contribution of utility-scale energy storage for meeting peak demand.

Firm Capacity (kW, MW): The amount of installed capacity that can be relied upon to meet demand during peak periods or other high-risk periods. The share of firm capacity to the total installed capacity of a generator is known as its **capacity credit (%)**.[3]

Capacity Value ($): The monetary value of the contribution of a generator (conventional, renewable, or storage) to balancing supply and demand when generation is scarce.

Operating Reserves and Ancillary Services: To maintain reliable power system operations, generation must exactly match electricity demand at all times. There are various categories of operating reserves and ancillary services that function on different timescales, from subseconds to several hours, all of which are needed to ensure grid reliability. BESS can rapidly charge or discharge in a fraction of a second, faster

3. See Mills and Wiser (2012) for a general treatment on the concept of capacity credit.

than conventional thermal plants, making them a suitable resource for short-term reliability services, such as Primary Frequency Response (PFR) and Regulation. Appropriately sized BESS can also provide longer-duration services, such as **load-following and ramping** services, to ensure supply meets demand.

Transmission and Distribution Upgrade Deferrals: The electricity grid's transmission and distribution infrastructure must be sized to meet peak demand, which may only occur over a few hours of the year. When anticipated growth in peak electricity demand exceeds the existing grid's capacity, costly investments are needed to upgrade equipment and develop new infrastructure. Deploying BESS can help defer or circumvent the need for new grid investments by meeting peak demand with energy stored from lower-demand periods, thereby reducing congestion and improving overall transmission and distribution asset utilization. Also, unlike traditional transmission or distribution investments, mobile BESS installations can be relocated to new areas when no longer needed in the original location, increasing their overall value to the grid.

Black Start: When starting up, large generators need an external source of electricity to perform key functions before they can begin generating electricity for the grid. During normal system conditions, this external electricity can be provided by the grid. After a system failure, however, the grid can no longer provide this power, and generators must be started through an on-site source of electricity, such as a diesel generator, a process known as black start. An on-site BESS can also provide this service, avoiding fuel costs and emissions from conventional black-start generators. As system-wide outages are rare, an on-site BESS can provide additional services when not performing black starts.

Table 1 below summarizes the potential applications for BESS in the electricity system, as well as whether the application is currently valued in U.S. electricity markets (Denholm 2018). Figure 2 shows the cumulative installed capacity (MW) for utility-scale storage systems in the United States in 2017 by the service the systems provide.

Most storage systems in the United States provide operating reserves and ancillary services. Despite this current focus, the total U.S. market for these services is limited, and utility-scale storage may begin providing more firm and peak capacity in the near future.

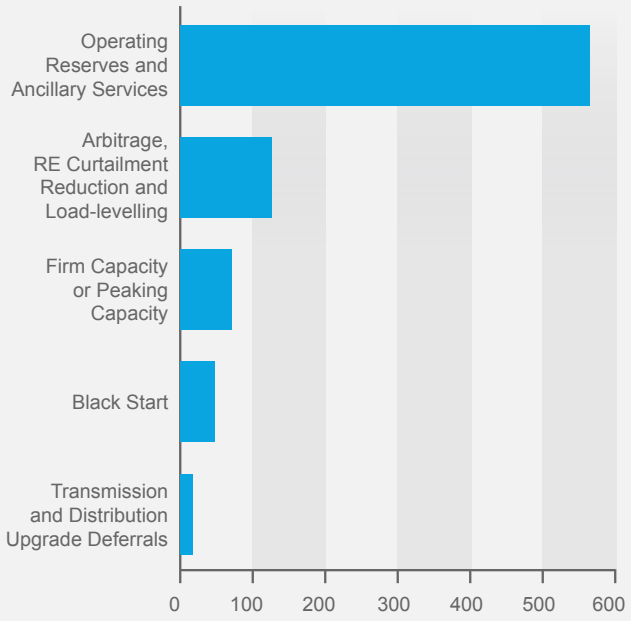


Figure 2: U.S. Utility-scale battery storage capacity by service. *Data source: U.S. Energy Information Administration, Form EIA-860, Annual Electric Generator Report*

Where should batteries be located?

Utility-scale BESS can be deployed in several locations, including: 1) in the transmission network; 2) in the distribution network near load centers; or 3) co-located with VRE generators. The siting of the BESS has important implications for the services the system can best provide, and the most appropriate location for the BESS will depend on its intended-use case.

In many cases, a BESS will be technically capable of providing a broad range of services in any of the locations described in the next section. Therefore, when siting storage, it is important to analyze the costs and benefits of multiple locations to determine the optimal siting to meet system needs. Considering all combinations of services the BESS can provide at each potential site will provide a better understanding of the expected revenue streams (see *What is value-stacking?*) and impact on the grid.

In the Transmission Network

BESS interconnected to the transmission system can provide a broad range of ancillary and transmission-related services. These systems can be deployed to replace or defer investments of peaking capacity, provide operating reserves to help respond to changes in generation and demand, or they can be used to defer transmission system upgrades in regions experiencing congestion from load or generation growth. Figure 3 below shows the configuration of a utility-scale storage system interconnected at the transmission substation level.

In the Distribution Network Near Load Centers

Storage systems located in the distribution network can provide all of the services as transmission-sited storage, in addition to several services related to congestion and power quality issues. In many areas, it may be difficult to site a conventional generator near load in order to provide peaking capacity, due to concerns about emissions or land use. Due to their lack of local emissions and their scalable nature, BESS systems can be co-located near load with fewer siting challenges than conventional generation. Placing storage near load can reduce transmission and distribution losses and relieve congestion, helping defer transmission and distribution upgrades. Distribution-level BESS systems can also provide local power quality services and support improved resilience during extreme weather events.

Table 1: Applications of Utility-Scale Energy Storage

Application	Description	Duration of Service Provision	Typically Valued in U.S. Electricity Markets?
Arbitrage	Purchasing low-cost off-peak energy and selling it during periods of high prices.	Hours	Yes
Firm Capacity	Provide reliable capacity to meet peak system demand.	4+ hours	Yes, via scarcity pricing and capacity markets, or through resource adequacy payments.
Operating Reserves			
• Primary Frequency Response	Very fast response to unpredictable variations in demand and generation.	Seconds	Yes, but only in a limited number of markets.
• Regulation	Fast response to random, unpredictable variations in demand and generation.	15 minutes to 1 hour	Yes
• Contingency Spinning	Fast response to a contingency such as a generator failure.	30 minutes to 2 hours	Yes
• Replacement/ Supplemental	Units brought online to replace spinning units.	Hours	Yes, but values are very low.
• Ramping/Load Following	Follow longer-term (hourly) changes in electricity demand.	30 minutes to hours	Yes, but only in a limited number of markets.
Transmission and Distribution Replacement and Deferral	Reduce loading on T&D system during peak times.	Hours	Only partially, via congestion prices.
Black-Start	Units brought online to start system after a system-wide failure (blackout).	Hours	No, typically compensated through cost-of-service mechanisms.

Co-Located with VRE Generators

Renewable resources that are located far from load centers may require transmission investments to deliver power to where it is needed. Given the variable nature of VRE resources, the transmission capacity used to deliver the power may be underutilized for large portions of the year. A BESS can reduce the transmission capacity needed to integrate these resources and increase the utilization of the remaining capacity by using storage to charge excess generation during periods of high resource availability and discharge during periods of low resource availability. The same BESS can be used to reduce the curtailment of VRE generation, either due to transmission congestion or a lack of adequate demand, as well as provide a broad range of ancillary services.

What is value-stacking? What are some examples of value-stacking opportunities and challenges?

BESS can maximize their value to the grid and project developers by providing multiple system services. As some services are rarely called for (i.e., black start) or used infrequently in a given hour (i.e., spinning reserves), designing a BESS to provide multiple services enables a higher overall battery utilization. This multi-use approach to BESS is known as **value-stacking**. For example, a BESS project can help defer the need for new transmission by meeting a portion of the peak demand with stored energy during a select few hours in the year. When not meeting peak demand, the BESS can earn revenue by providing operating reserve services for the transmission system operator.

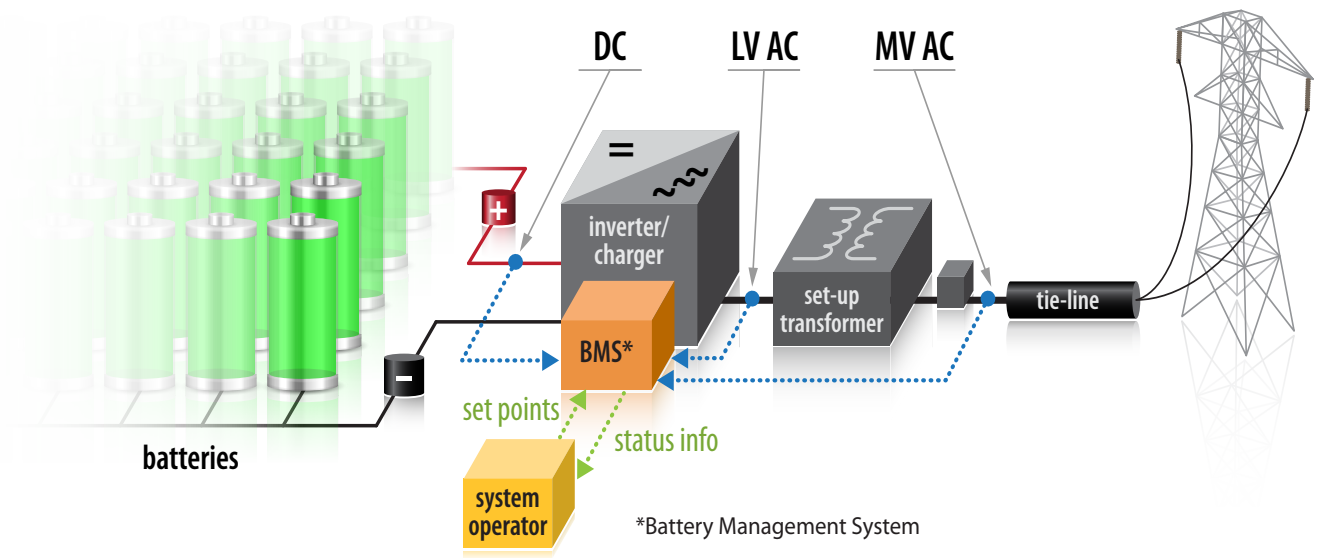


Figure 3: Key components of BESS interconnected at the transmission substation level. LV AC represents a low-voltage AC connection, while MV AC represents a medium-voltage AC connection.[4] *Source: Denholm (2019)*

Some system services may be mutually exclusive depending on the BESS design (e.g., a short duration storage device used to supply regulating reserves would have limited value for deferring transmission or distribution upgrades). Even if a BESS is technically capable of providing multiple services, the additional cycling of the battery (charging and discharging) may degrade the battery and shorten its lifetime and economic viability. Finally, a BESS can only provide a limited duration of any set of services before it runs out of charge, which means batteries must prioritize the services they provide.

Regulators have a variety of options to enable BESS to maximize its economic potential through value-stacking. For example, the California Public Utilities Commission (CPUC) developed categories of services BESS can provide based on their importance for reliability and location on the grid, as well as 12 rules for utilities when procuring services from BESS (CPUC 2018). The CPUC rules:

- Dictate that BESS projects can only provide services at the voltage level to which they are interconnected or higher, but not lower[5];
- Prioritize reliability services over non-reliability services and ensure storage cannot contract for additional services that would interfere with any obligation to provide reliability services;
- Require that a BESS project comply with all performance and availability requirements for services it provides and that noncompliance penalties be communicated in advance;
- Require that a BESS project inform the utility of any services it currently provides or intends to provide; and
- Take measures to prevent double compensation to BESS projects for services provided.

These CPUC rules are just one example of how regulators can help ensure BESS projects can select the most cost-effective combinations of services to provide without negatively impacting the reliability of the grid.

How are BESS operators compensated?

BESS operators can be compensated in several different ways, including in the wholesale energy market, through bilateral contracts, or directly by the utility through a cost-of-service mechanism. In a wholesale energy market, the BESS operator submits a bid for a specific service, such as operating reserves, to the market operator, who then arranges the valid bids in a least-cost fashion and selects as many bids as necessary to meet the system's demands. If the BESS operator's bid is selected and the BESS provides the service, the operator will receive compensation equal to the market price. This process ensures transparent prices and technology-agnostic consideration; however, many services are currently not available in the market, such as black start or transmission and distribution upgrade deferrals. Alternatively, BESS operators can enter into bilateral contracts for services directly with energy consumers, or entities which procure energy for end-consumers. This process does not ensure transparency and contracts can differ widely in both prices and terms. Finally, some BESS are owned directly by the utilities to whom they provide services, such as upgrade deferrals. In these cost-of-service cases, the utility pays the BESS operator at the predetermined price and recovers the payments through retail electricity rates. In some jurisdictions, however, BESS may be prevented from extracting revenues through both wholesale markets and cost-of-service agreements (Bhatnagar et al. 2013).

4. ANSI C84.1: Electric Power Systems and Equipment–Voltage Ratings (60 Hz) defines a low-voltage system as having a nominal voltage less than 1 kV and medium voltage as having a nominal voltage between 1 kV and 100 kV.
5. BESS interconnected at the distribution level can provide distribution or transmission level services, but BESS interconnected at the transmission level can only provide transmission-level services.

How does the value of batteries change with renewable energy deployment and increased VRE penetration?

The amount of renewable energy on the grid can influence the value and types of the services provided by a BESS. Increased levels of renewable energy may increase the need for frequency control services to manage increased variability and uncertainty in the power system. Increased levels of VRE penetration can also change the shape of the net load, or the load minus the VRE generation, influencing BESS projects that provide load following, arbitrage, peaking capacity, or similar services.

Models of the California system have shown a strong relationship between solar PV deployment and BESS' ability to replace conventional peaking capacity, also known as the BESS capacity credit (Denholm and Margolis 2018). As the shape of the load curve affects the ability of storage to provide peaking capacity, resources such as PV that cause load peaks to be shorter will enable shorter duration batteries, which are less expensive, to displace conventional peaking capacity.

Initially, low levels of PV penetration may flatten the load curve, reducing BESS' ability to cost-effectively offset the need for conventional peaking plants.[6] At higher levels of solar PV penetration, however, the net load curve becomes peakier, increasing the ability and value of BESS to reduce peak demand. Figure 4 illustrates how increasing levels of PV generation change the shape of the net load, causing it to become peakier. The shaded areas above and under the net load curves indicate BESS charging and discharging, while the text boxes show the amount of net load peak reduction (MW) and the total amount of energy met by BESS during the net load peak (MWh).

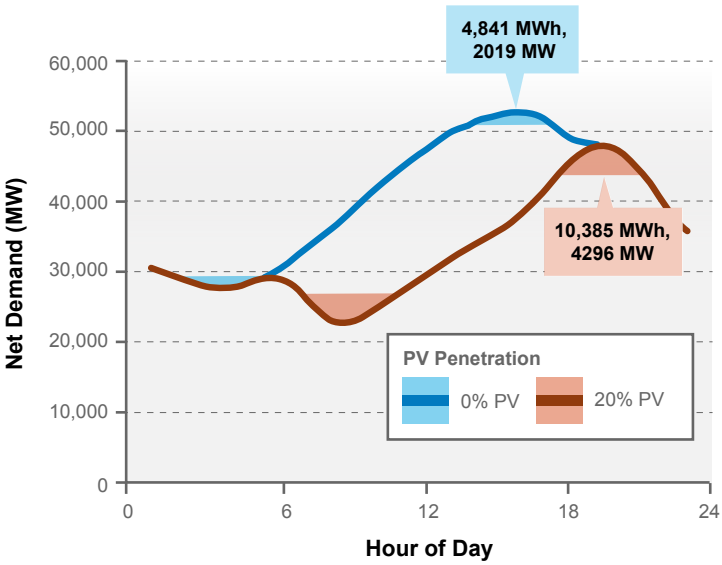


Figure 4: Change in California net load shape due to PV.
Adapted from Denholm and Margolis (2018)

What are the key barriers to BESS deployment?

Barriers to energy storage deployment can be broadly grouped into three different categories: regulatory barriers, market barriers, and data and analysis capabilities.

1. *Regulatory Barriers*

- **Lack of rules and regulations to clarify the role of BESS.** Although storage may be technically able to provide essential grid services, if no regulations or guidelines explicitly state that storage can provide these services, utilities and market operators may be unwilling to procure services from BESS. Furthermore, without a guarantee that services provided by a BESS project will be compensated, storage developers and financing institutions may be unwilling to make the necessary capital investments. Federal Energy Regulatory Commission (FERC) Order 841 addressed this issue in U.S. wholesale markets and directed market operators to develop rules governing storage's participation in energy, capacity, and ancillary service markets. Among other requirements, the rules must ensure open and equal access to the market for storage systems, taking into consideration their unique operating and technical characteristics (FERC 2018).

- **Restrictions or lack of clarity around if and how storage can be used across generation, transmission, and distribution roles.** The variety of different services storage can provide often cuts across multiple markets and compensation sources. For instance, frequency regulation may be compensated in a wholesale market, but transmission or distribution investment deferrals may be compensated as a cost of service by the utility or system operator. In some jurisdictions, providing services across different compensation sources is restricted by regulation. Limiting the services batteries can provide based on where the service is provided or how it is compensated can influence how often they are utilized and whether they remain an economic investment (Bhatnagar 2013).

2. *Market Barriers*

- **Lack of markets for system services.** A lack of markets for services that batteries are uniquely suited to provide can make it difficult for developers to include them as potential sources of income when making a business case, deterring investment. For example, in most U.S. Independent System Operator (ISO) markets, generators are currently expected to provide inertial and governor response during frequency excursions without market compensation. Although BESS can provide the same services, currently there is no way for BESS to seek market compensation for doing so. Furthermore, the price formation for a service may have evolved for conventional generators, meaning the presence

6. This is demonstrated by Denholm and Margolis (2018) for the California system.

of batteries in the market could distort prices, affecting storage systems and conventional generators alike (Bhatnagar 2013).

- **Lack of discernment in quality and quantity of services procured.** For some services, such as frequency regulation, the speed and accuracy of the response is correlated to its overall value to the system. Battery systems can provide certain services much faster and more accurately than conventional resources, which may not be reflected in compensation for the service. Markets can provide fair compensation to BESS by aligning compensation schemes with the quality of service provided, as is mandated by FERC Order 755, which requires compensation for frequency regulation that reflects "the inherently greater amount of frequency regulation service being provided by faster-ramping resources" (FERC 2011). Similarly, BESS can be uniquely suited to provide up- or down-regulation, given their larger operating range over which to provide regulating reserves (due to their lack of a minimum stable level and ability to provide up- and down-regulation in excess of their nameplate capacity, based on whether they are charging or discharging) (Denholm 2019). These unique features of BESS are not necessarily reflected in the procurement requirements and compensation of such services, diminishing BESS' economic viability.

3. ***Data and Analysis Capabilities***

   Battery storage systems are an emerging technology that exhibit more risk for investors than conventional generator investments. These risks include the technical aspects of battery storage systems, which may be less understood by stakeholders and are changing faster than for other technologies, as well as potential policy changes that may impact incentives for battery deployment. Given the relatively recent and limited deployment of BESS, many stakeholders may also be unaware of the full capabilities of storage, including the ability of a BESS to provide multiple services at both the distribution and transmission level. At the same time, traditional analysis tools used by utilities may be inadequate to fully capture the value of BESS. For example, production cost models typically operate at an hourly resolution, which does not capture the value of BESS' fast-ramping capabilities. The gaps in data and analysis capabilities and lack of adequate tools can deter investments and prevent battery storage from being considered for services that can be provided by better understood conventional generators (Bhatnagar et al. 2013).

What are some real-world examples of batteries providing services and value-stacking?

There are several deployments of BESS for large-scale grid applications. One example is the Hornsdale Power Reserve, a 100 MW/129 MWh lithium-ion battery installation, the largest lithium-ion BESS in the world, which has been in operation in South Australia since December 2017. The Hornsdale Power Reserve provides two distinct services: 1) energy arbitrage; and 2) contingency spinning reserve. The BESS can bid 30 MW and 119 MWh of its capacity directly into the market for energy arbitrage, while the rest is withheld for maintaining grid frequency during unexpected outages until other, slower generators can be brought online (AEMO 2018). In 2017, after a large coal plant tripped offline unexpectedly, the Hornsdale Power reserve was able to inject several megawatts of power into the grid within milliseconds, arresting the fall in grid frequency until a gas generator could respond. By arresting the fall in frequency, the BESS was able to prevent a likely cascading blackout.

Another example of value-stacking with grid-scale BESS is the Green Mountain Power project in Vermont. This 4 MW lithium-ion project began operation in September 2015 and is paired with a 2 MW solar installation. The installation provides two primary functions: 1) backup power and micro-grid capabilities; and 2) demand charge reductions. The solar-plus-storage system enables the utility to create a micro-grid, which provides power to a critical facility even when the rest of the grid is down. The utility operating the BESS also uses it to reduce two demand charges: an annual charge for the regional capacity market and a monthly charge for the use of transmission lines. Sandia National Laboratories estimated that reducing the annual demand charge for a single year saved the utility over $200,000 (Schoenung 2017).

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Written by Thomas Bowen, Ilya Chernyakhovskiy, Paul Denholm, National Renewable Energy Laboratory

www.greeningthegrid.org | www.nrel.gov/usaid-partnership

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NREL/TP-6A20-74426 | September 2019
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The Grid Integration Toolkit provides state-of-the-art resources to assist developing countries in integrating variable renewable energy into their power grids. Greening the Grid is supported by the U.S. Agency for International Development.

The USAID-NREL Partnership addresses critical challenges to scaling up advanced energy systems through global tools and technical assistance, including the Renewable Energy Data Explorer, Greening the Grid, the International Jobs and Economic Development Impacts tool, and the Resilient Energy Platform. More information can be found at: **www.nrel.gov/usaid-partnership**.

Valley Regional Fire Authority
Selfless Service. Integrity. Grit.

VRFA Headquarters, 1101 D Street NE, Auburn, WA 98002
(253) 288-5800 · vrfa.org · askthevrfa@vrfa.org

The increasing use of commercial-scale Battery Energy Storage Systems (BESS) introduces new safety and emergency response challenges. As the Valley Regional Fire Authority (VRFA) adapts to these emerging technologies, it is essential to focus on site design, hazardous material management, proper personnel training, and having a well-structured emergency response plan. These elements are critical for ensuring a safe and effective response to any BESS incident.

To manage these risks, VRFA relies on the International Fire Code (IFC) and the National Fire Protection Association (NFPA) standards while evaluating all proposed development that falls within our purview. The proposed project will follow the 2023 edition of NFPA 855, Standard for the Installation of Stationary Energy Storage Systems, and the amended Chapter 12 of the Washington State IFC, which took effect on March 15, 2024, through an emergency ruling by the State Building Council to ensure the most current safety measures can be applied towards BESS development. Additionally, the project will adhere to the City of Auburn (COA) Engineering and Design Standards (EDS), interpreting all other IFC codes from the appropriate code cycle for the project.

To allow Valley Regional Fire Authority to follow the best practices for emergency response outlined in Tesla's Industrial Lithium-Ion Battery Emergency Response Guide for the Megapack, onsite hydrants meeting section 7.06.01 of COA EDS will be required. Each Tesla Megapack must follow the commercial hydrant spacing requirements for commercial development. With the probability of water being applied during an emergency fire event at the property, onsite water containment should be considered to help prevent contaminated runoff into the nearby protected wetlands.

VRFA is an all-hazards fire agency and will respond to all fire, medical, and other emergencies within the cities of Algona, Auburn, Pacific, and Fire District 31. This would include any emergency incidents at BESS facilities. However, any response to a BESS site, especially a fire or discharge event, would likely require both local and regional assets due to the unique features and risks associated with these sites.

A fire or discharge incident at a BESS facility would be treated as a hazardous materials incident. All VRFA emergency response personnel are trained to an Operations level for hazardous materials

response as defined in WAC 296-824-30005, Safety Standards for Emergency Response, while three are trained to the higher Technician level. This distribution is similar in other local fire departments. Because of these training levels and the high-risk, low frequency nature of hazardous materials incidents, the VRFA and our regional partners rely on automatic and mutual aid agreements to respond to and mitigate hazardous materials incidents.

Response modeling determines the type, number, and order of emergency response assets to incidents based on established risk management criteria. Currently, an initial hazardous emergency response to a BESS site in Auburn would include VRFA, Puget Sound Regional Fire Authority, South King Fire and Rescue, and Renton Regional Fire Authority, at minimum. Combined with a fire response, there may be a significant impact on the area and the availability of fire-based resources. Furthermore, a review of previous incidents has shown that these emergencies span multiple operational periods – i.e., 12 or more hours – as the prescribed method for remediation of thermal events is to let the systems burn. This may necessitate extended evacuations and/or road closures due to smoke, water runoff from exposure protection, and the large presence of emergency vehicles. Finally, a prolonged response to a BESS would require coordinated public safety response and ongoing messaging to the community from VRFA, the City of Auburn, and other partners.

IDAHO POWER

Incident Review—
Melba Battery Fire

Presentation to Canyon County

October 18, 2023

Topics to Cover

- ☑ Melba Incident Review
- ☑ Air Quality Testing Results
- ☑ Fire Response & Investigation
- ☑ Inspection & Remediation
- ☑ Other Lessons Learned
- ☑ Current & Future Battery Storage Needs

Introductions

- Megan Ronk, Economic Development & Innovations Director
- Eric Hackett, Projects & Design Senior Manager
- Bill Norris, Environmental Compliance Manager
- Angelique Rood, Regional Manager

Melba Incident Review

- The fire was reported to Idaho Power at 5:20 a.m., Monday Oct. 2
- Idaho Power arrived on-site at 6:02 a.m.
- Neighbors were encouraged to evacuate, hotels offered
- Fire responders reported on-site, no action needed
- Roads were closed to maintain a 200 ft perimeter
- Regular updates to fire, city, and county throughout event
- Industrial Hygiene Professionals arrived to begin air quality testing at approximately 11:00 a.m.
  - National firm with mobile instrumentation arrived Tuesday, Oct. 3

Air Quality Testing Results

- 3rd party real-time air monitoring
  - Immediate monitoring conducted afternoon and evening of Oct. 2
  - Continuous monitoring performed evening of Oct. 3–Oct. 5 (duration of fire)
  - Analyte selection: vendor material information and common contaminants from fires
  - Sampling locations based on nearby residential dwellings and prevailing winds

No detected analytes above health-based action levels

Fire Response & Investigation

- Idaho Power and battery supplier monitored 24x7 until fire was extinguished
- Advised by battery supplier to not add water or retardant, consistent with current industry practices

Fire Response & Investigation

- Comprehensive investigation at Melba
  - Battery supplier believes the root cause to be water intrusion
  - Short-circuit caused heat that ignited the battery cells
  - Fire spread between battery segments until it burned out
- Supplier believes that an identified defective unit is where the fire originated due to water intrusion
- Idaho Power third-party experts engaged to provide independent conclusions and recommend appropriate mitigation measures
- Developing plans for removal

Inspection & Remediation

- Melba incident has emphasized heightened need and awareness for inspection and remediation across Idaho Power battery systems
  - Meet specifications, codes, and testing ratings
  - Ensure safe operation
  - Ensure emergency response clarity
- Complete inspection of all battery systems with supplier and independent third-party
  - Water intrusion
  - Defects
  - Mitigation measures and success

Inspection & Remediation

- Determine appropriate mitigation strategies
  - Resolve water intrusion
  - Reduce propagation between battery segments
- Consult with third-party experts to ensure ongoing safe operation
- Develop additional procedures, processes, inspection protocols, and contingency plans
- Complete rigorous technical and engineering diligence and specification review of future suppliers

Other Lessons Learned

- Improved coordination with stakeholders **prior** to battery installation is necessary
  - Training with public safety partners
  - Better communication with city and county officials

- Idaho Power staff to be better equipped with information on battery units to aid in communication and information sharing
- Previous work with Canyon County aided in cooperation during the event
  - Messaging was timely, coordinated, and accurate

Other Lessons Learned

- Operational experience
  - Establish subject expertise
  - Mitigation strategies
  - Contingency planning
  - Emergency response

Current & Future Battery Storage Needs

- Growth info
  - Capacity needs- 23% customer growth in Canyon County (2018-2023)
- Why Melba specifically
  - Steady load growth
  - Batteries supports local peak demand and help meet system needs
  - Affordable and reliable
  - Local resiliency benefits
- Other Canyon County installations
  - Happy Valley Substation (Nampa)

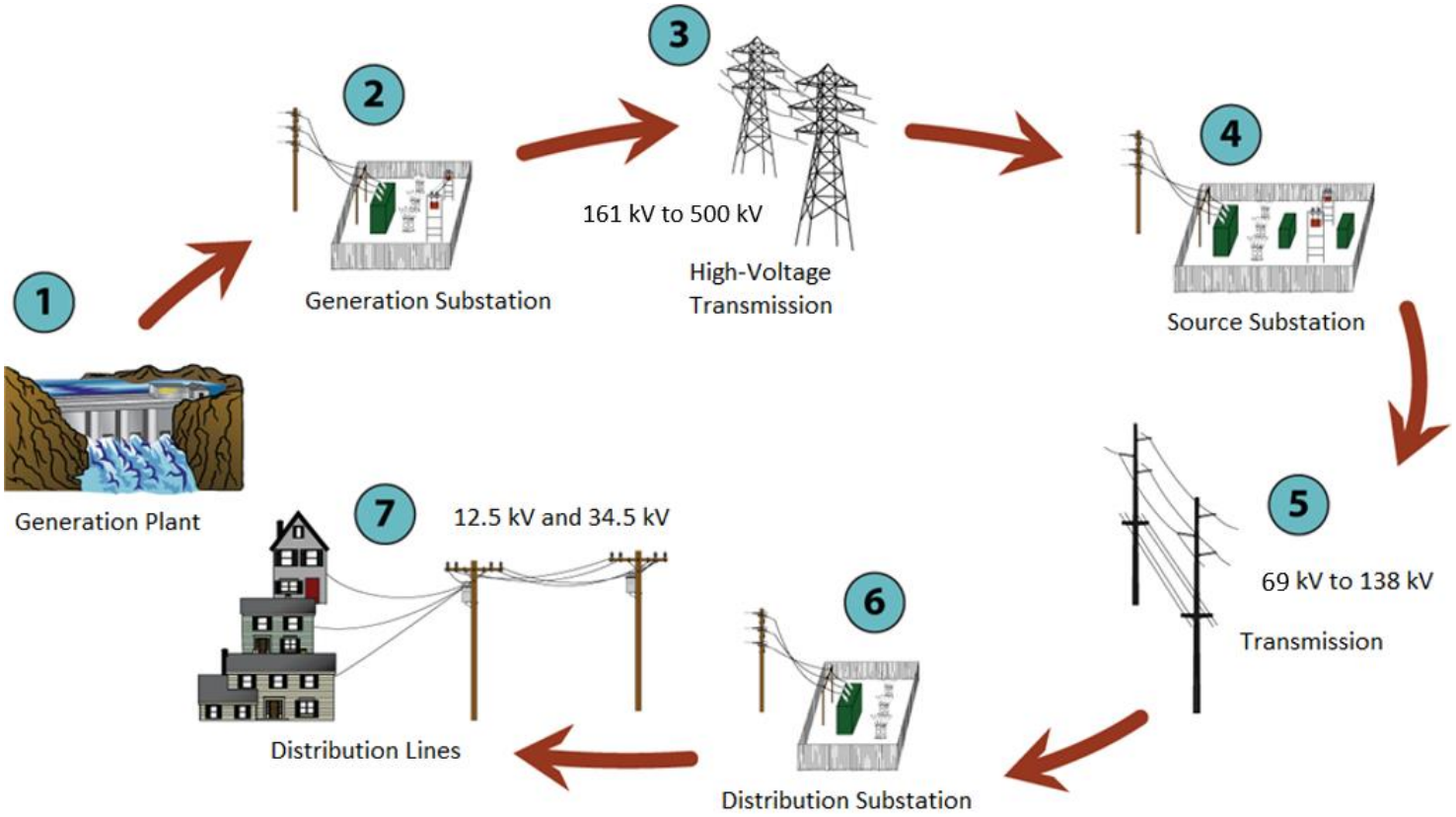
Melba Project Timeline

- Need identified in spring 2021
  - Transformer overload given sustained growth in Melba
  - 2-MW four-hour battery storage system
  - Defer transformer upgrade by 10+ years
- Supplier solicitation, review, and contract through the end of 2021
  - Numerous suppliers evaluated based on specification, timeline, and cost

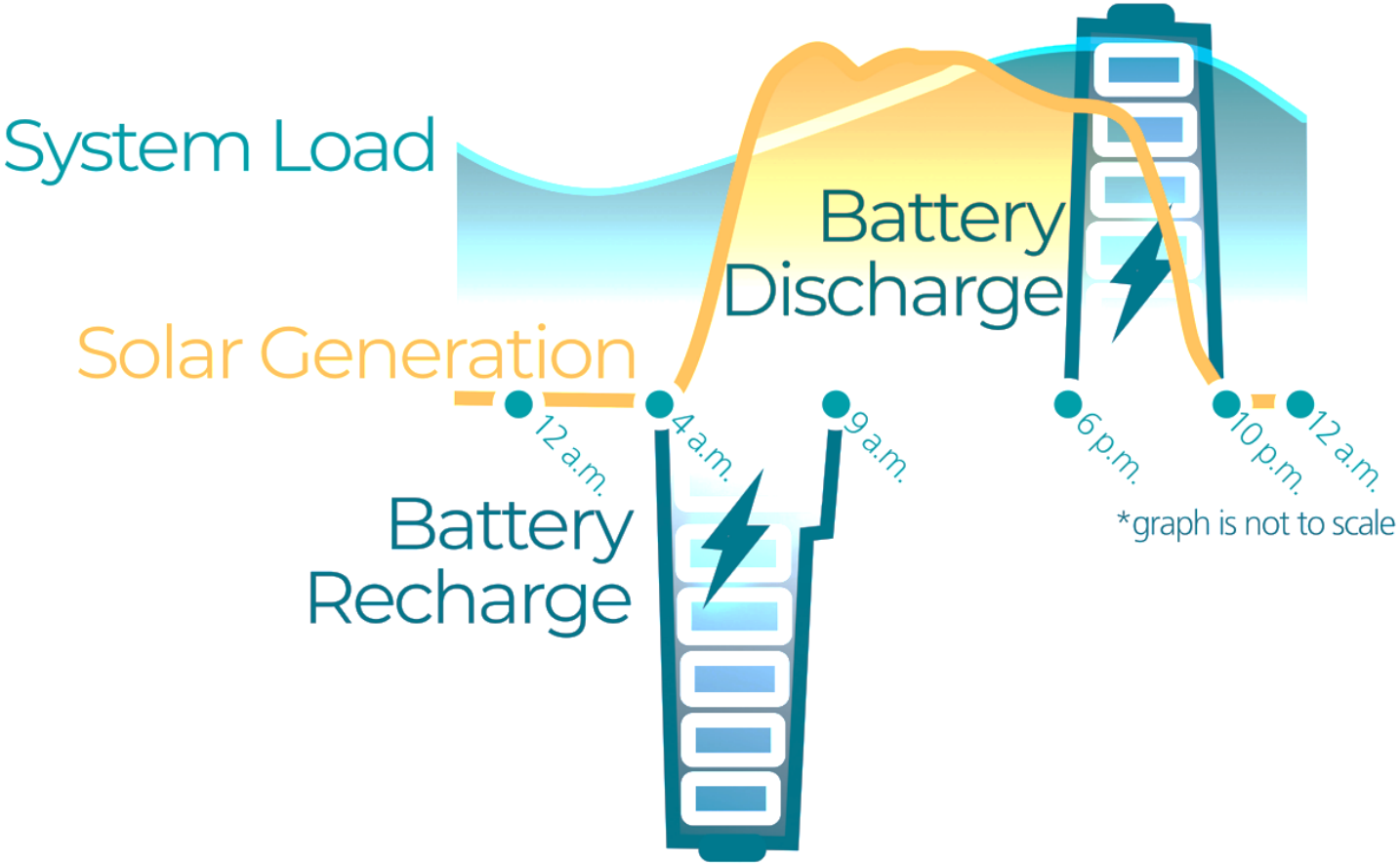
Melba Project Timeline

- Batteries were delivered/installed in summer 2023
- Testing/commissioning began in September 2023
  - Control electronics, monitoring equipment, auxiliary power, fire suppression system, HVAC
- Expected to be fully operational in early October

Our Electric Grid



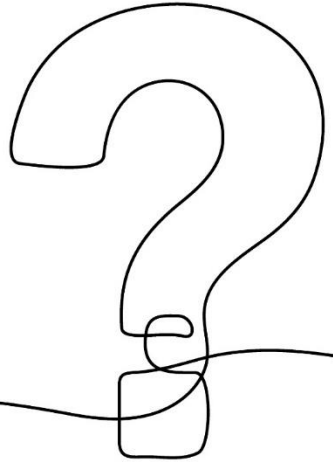
How Batteries Can Help



The Future of Battery Storage

- Industry is advancing technology, including safe operations
  - Worldwide, batteries are generally proven and safe
  - Supplier/industry expertise
  - Battery experts
  - Community collaboration
- Affordable and reliable
  - Anticipated in Idaho Power Integrated Resource Plan
- Provide ability to store energy to meet customer needs at any time
  - Potential to support economic development and meet timelines
  - Support local needs as well as system benefits

Questions



ORDINANCE NO. 07-2024

AN ORDINANCE OF THE CITY COUNCIL OF THE CITY OF COVINGTON, WASHINGTON, RELATING TO ADOPTING A TEMPORARY 12-MONTH MORATORIUM ON THE ACCEPTANCE, PROCESSING, AND/OR APPROVAL OF APPLICATIONS FOR BUILDING AND LAND DEVELOPMENT PERMITS AND RELATED LAND USE DECISIONS FOR BATTERY ENERGY STORAGE SYSTEM FACILITIES PROPOSED TO BE LOCATED IN ANY ZONE WITHIN THE CITY OF COVINGTON; SCHEDULING A PUBLIC HEARING; RECOGNIZING THAT A WORK PLAN WILL BE ESTABLISHED; ADOPTING FINDINGS OF FACT; PROVIDING FOR SEVERABILITY; DECLARING AN EMERGENCY; AND ESTABLISHING AN IMMEDIATE EFFECTIVE DATE.

WHEREAS, within the express terms of the Covington Municipal Code ("CMC") and the Growth Management Act, the Washington State Legislature has conferred upon the governing bodies of Washington code cities the right to establish and adopt moratoria related to land uses, as set forth in RCW 35A.63.220 and RCW 36.70A.390; and

WHEREAS, a moratorium is a pause on all new development, land use, and construction applications, which allows cities to consider new development and zoning regulations; and

WHEREAS, Battery Energy Storage System (BESS) facilities are installations designed to store electrical energy for later use, typically consisting of batteries, power conversion systems, and control equipment; and

WHEREAS, the primary function of BESS facilities is to store excess electricity generated during periods of low demand or high renewable energy production, such as from solar or wind sources. This stored energy can then be discharged when demand is high or when renewable energy generation is low, helping to stabilize the electrical grid and improve overall energy reliability; and

WHEREAS, time is needed for the City of Covington ("City") to study whether battery energy storage system facilities are compatible and should be allowed within City limits, either as a permitted or conditional use, and if so, in which zone(s) and whether current zoning regulations in Title 18 CMC and/or other official controls and development standards need to be updated to ensure such facilities can be safely and appropriately sited within the City; and

WHEREAS, the City's development regulations, and specifically the definition of "Utility Facility" in CMC 18.20.050 and the permitted and conditional uses provided in CMC Chapter 18.125.040, have not been updated to reflect recent technological changes and business models in the energy storage and electric utility industry; and

WHEREAS, applying these outdated regulations in Title 18 CMC to new technologies and business models could lead to approval of battery energy storage system facility projects that are undesirable, unsafe, and/or inconsistent with long-term planning goals and objectives of the City, particularly when the existing regulations have not been reviewed and updated for best practices nor reconsidered in light of technological changes and potential effects such facilities have on surrounding areas and community resources; and

WHEREAS, the City Council of the City of Covington ("City Council") has determined the following facts, and identified the following unknown risks and economic factors, that may be relevant in assessing the desirability of, and siting concerns associated with, battery energy storage system facilities in the City:

A. Battery energy storage systems are essentially rechargeable battery arrays that store excess energy when demand on the electrical grid is low and can feed power back into the system when demand is high (or energy production is low).
B. The elements used in batteries can pose risks of explosion from overheating and of environmental contamination.
C. Battery energy storage system facilities present fire hazards that can take weeks to extinguish, requiring massive volumes of water and chemicals to bring under control.
D. Battery energy storage system facilities are sites where hazardous chemicals such as cyanide and hydrofluoric acid are present and thus pose the potential for discharge to surrounding property, air, and groundwater in the event of a fire.
E. Battery energy storage system facilities create a potential for air quality hazards in the event of a fire.
F. Battery energy storage system facilities may produce noise and visual impacts that are not currently well understood by the city.
G. Battery energy storage system facilities may produce impacts on wildlife that are not currently well understood by the city.
H. Battery energy storage system facilities may be more appropriate for heavy industrial zones than commercial, neighborhood retail offices, or residential zones.
I. Battery energy storage system facilities may create additional strain on local emergency response agencies and their personnel.
J. The Washington State Department of Ecology is beginning to compile guidance on battery energy storage system facility sites that the City wishes to study before updating its zoning and other regulations applicable to battery energy storage system facilities.
K. The Washington State Legislature adopted House Bill 1216 in 2023, and new Washington State regulations codified at WAC 51.54A.0322 which are intended to minimize the risks of lithium-ion battery energy storage system facilities through fire safety requirements and construction standards and will take effect soon. The City desires to study these new laws and regulations to determine what effects they will have on local regulatory authority. King County is studying whether its codes need updating to add conditions for approving these types of facilities, including zoning, safety, and insurance requirements. The City desires

to learn about King County's regulatory initiatives before finalizing updates to the City's zoning regulations and official controls.

L. Puget Sound Energy ("PSE"), which is conducting Requests For Proposals for third-party private entities to develop energy storage facilities connected via high-voltage transmission lines to PSE's regional substations, has published safety and reliability requirements for such facilities that need to be explored and better understood before the City can determine whether to permit battery energy storage system facilities in the City, and under what conditions.

M. It is unknown what fiscal or economic development benefits would flow to the City if battery energy storage system facilities were permitted within the City or which zone(s) would be most advantageous for siting them. The City needs to investigate and analyze potential economic impacts and tax revenues associated with such projects.

WHEREAS, due to the unique characteristics of battery energy storage system facilities, certain existing requirements in the CMC may not appropriately address or mitigate the community impacts and risks such facilities may present; and

WHEREAS, processing applications for land use approvals, development permits, and related applications or code interpretations for battery energy storage system facilities under existing zoning regulations and other official controls could potentially result in approvals of undesirable and incompatible development until such time that the City has properly reviewed its regulations and implemented any zoning code revisions or additional controls deemed necessary and proper for the health, safety, and general welfare of the City and its residents; and

WHEREAS, the City's Comprehensive Plan update includes analysis and recommendations for needed zoning code amendments to implement the Land Use element and Economic Development element of the Comprehensive Plan following its anticipated adoption in December 2024; and

WHEREAS, it would be an efficient use of resources and an appropriate exercise of its planning authority under the Growth Management Act and Chapter 35A.63 RCW for the City to integrate an analysis of whether, and under what regulatory parameters, battery energy storage system facilities should be allowed uses within the City with the City's ongoing work on the Land Use chapter and other elements of the Comprehensive Plan and development regulations; and

WHEREAS, the City Council has significant concerns about whether battery energy storage system facilities can be appropriately reviewed and analyzed under current regulations and finds that unless the City acts immediately to preserve the status quo, there are likely to be adverse impacts on the City and the health, safety, and welfare of its citizens; and

WHEREAS, pursuant to RCW 35A.63.220 and RCW 36.70A.390, the City may adopt a moratorium that is effective for no longer than six months but may adopt a moratorium that is effective for up to 12 months if a work plan is developed for conducting appropriate studies and analyses over that longer period; and

WHEREAS, to promote public health, safety, and welfare, the City Council deems it necessary and proper to impose a moratorium on land use and development permit applications related to battery energy storage system facilities for a period of 12 months; and

WHEREAS the City Council deems it appropriate to hold a public hearing on June 11, 2024, and may adopt additional findings following the conclusion of said public hearing; and

WHEREAS, the City possesses land use jurisdiction and regulatory authority over the City's incorporated lands; and

WHEREAS, the adoption of this moratorium is exempt from the threshold determination requirements under the State Environmental Policy Act; and

WHEREAS, Council's desire to maintain the status quo justifies the declaration of an emergency and the designation of this ordinance as a public emergency ordinance necessary for the protection of public health, public safety, public property, or the public peace by the Council; and

WHEREAS, the potential adverse impacts on public health, property, safety, and welfare of the City and its citizens if this moratorium does not take effect immediately, further justifies the declaration of an emergency and the designation of this ordinance as a public emergency ordinance necessary for the protection of public health, public safety, public property, or the public peace by the Council; and

WHEREAS, Council finds that the enactment of this ordinance constitutes an emergency due to the need to immediately prevent the community detriment that would occur by allowing further self-service storage facility development proposals to vest under the current land use regulations; and

WHEREAS, RCW 35A.13.190 permits an ordinance to become effective immediately but requires that it must be passed by a majority plus one of the whole membership of Council to have such an effect; and

WHEREAS, the moratorium imposed herein promotes the public good and is necessary for the protection of public health, property, safety, and welfare. A public emergency exists requiring that the City's moratorium takes effect immediately upon adoption.

NOW, THEREFORE, The City Council of the City of Covington, Washington, do ordain as follows:

Section 1. Findings of Fact. The recitals set forth above are hereby adopted as the City Council's initial findings of fact in support of the moratorium established by this ordinance. The City Council may, in its discretion, adopt additional findings after the public hearing referenced in Section 3 below.

Section 2. Moratorium Imposed. Pursuant to RCW 35A.63.220, and RCW 36.70A.390, a temporary development moratorium is hereby imposed upon battery energy storage system facilities in any zone within the City of Covington. This moratorium also applies to the City's acceptance, processing, or approval of any applications for building permits and land use permits for battery energy storage system facilities, including without limitation:

A. Development permits;
B. Special use permits;
C. Building permits;
D. Clearing and grading permits;
E. Short plats;
F. Subdivisions;
G. Binding site plans;
H. Site plan reviews;
I. Conditional use permits;
J. Reasonable use exceptions;
K. Variances from Title 18 CMC regulations;
L. Deviations from any City of Covington engineering design and construction standards or other technical codes for any battery energy storage system facility within the City or any other type of development permit, approval, or code interpretation in connection with same; and
M. Any other development permits related to battery energy storage system facilities.

Section 3. Public Hearing. Pursuant to RCW 35A.63.220 and RCW 36.70A.390, the City Council will hold a public hearing at the City Council's regular meeting, at 7:00 p.m., on Monday, June 11, 2024, or as soon thereafter as the business of the City Council shall permit, in order to take public testimony on this moratorium and to consider adopting further findings of fact.

Section 4. Referral to Staff; Work Plan. City staff and the Covington Planning Commission are hereby authorized and requested, as part of their ongoing work on the 2024 Comprehensive Plan periodic update and review of current zoning regulations, to study the issues identified in this ordinance and to develop recommendations for whether battery energy storage system facilities should be allowed uses within the City and, if so, what zoning regulations and public processes are needed to protect the health, safety, and welfare of the community and ensure that such facilities are developed in a manner that is compatible with the overall plan and vision for the City. These recommendations shall be reviewed and considered by the Covington City Council for inclusion in the 2024 Comprehensive Plan update, Title 18 of the Covington Municipal Code, and/or other official controls of the City. This work plan is subject to change upon subsequent direction of the City Council following the public hearing referenced in Section 3 of this ordinance.

Section 5. Severability. If any section, paragraph, sentence, clause, or phrase of this ordinance, or its application to any person or situation, be declared unconstitutional or otherwise invalid for any reason, or should any portion of this ordinance be pre-empted by state or federal law or regulation, such decision or preemption shall not affect the validity of the remaining

portions of this ordinance or its application to other persons or situation. The City Council of the City of Covington hereby declares that it would have adopted this ordinance and each section, subsection, sentence, clauses, phrase, or portion thereof, irrespective of the fact that any one or more sections, subsections, sentences, clauses, phrases, or portions be declared invalid or unconstitutional.

Section 6. Corrections. Upon the approval of the city attorney, the city clerk and the codifiers of this ordinance are authorized to make any necessary corrections to this ordinance including, but not limited to, the correction of scrivener's/clerical errors, references, ordinance numbering, section/subsection numbers, and any reference thereto.

Section 7. Ratification. Any act consistent with the authority and prior to the effective date of this ordinance is hereby ratified and affirmed.

Section 8. Declaration of Emergency; Effective Date; Duration. The City Council hereby finds and declares that there is a significant potential for battery energy storage system facilities to create substantial adverse effects on public health, safety, and welfare if not addressed by adequate and appropriate development regulations; therefore, an emergency exists which necessitates that this ordinance become effective immediately in order to preserve the public health, safety, and welfare. Non-exhaustive underlying facts necessary to support this emergency declaration are included in the recitals above, all of which are adopted by reference as findings of fact as if fully set forth herein. This moratorium shall take effect immediately and shall remain in effect for 12 months, unless terminated earlier by the Council; provided, however, Council may, in its sole discretion, renew the moratorium for one or more six-month periods in accordance with state law. This ordinance or a summary thereof consisting of the title shall be published in the official newspaper of the City.

Passed by the City Council of the City of Covington this 14th day of May, 2024.

Signed in authentication of its passage this 14th day of May, 2024.

[Signature Page Follows]

Jeff Wagner, Mayor

EFFECTIVE: 05-14-2024
PUBLISHED: 05-17-2024

AUTHENTICATED:

Krista Bates, City Clerk

APPROVED AS TO FORM:

/s/ Mark Orthmann, as authorized by email on May 14, 2024

Mark Orthmann, City Attorney

FINAL BILL REPORT
E2SHB 1216

C 230 L 23
Synopsis as Enacted

Brief Description: Concerning clean energy siting.

Sponsors: House Committee on Appropriations (originally sponsored by Representatives Fitzgibbon, Doglio, Berry, Reed, Simmons, Macri, Fosse and Pollet; by request of Office of the Governor).

House Committee on Environment & Energy
House Committee on Appropriations
Senate Committee on Environment, Energy & Technology
Senate Committee on Ways & Means

Background:

Energy Facility Siting.
The Energy Facility Site Evaluation Council (EFSEC) was established in 1970 to provide a single siting process for major energy facilities. The EFSEC coordinates all evaluation and licensing steps for siting certain energy facilities, as well as specifies the conditions of construction and operation. After evaluating an application, the EFSEC submits a recommendation either approving or rejecting an application to the Governor, who makes the final decision on site certification. If approved by the Governor, a site certification agreement is issued in lieu of any other individual state or local agency permits.

The laws that require or allow a facility to seek certification through the EFSEC process apply to the construction, reconstruction, and enlargement of energy facilities, biorefineries, and electrical transmission facilities, with many specifications. Energy facilities of any size that exclusively use alternative energy resources, such as wind or solar energy, may opt into the EFSEC review and certification process. Energy facilities that exclusively use alternative energy resources that choose not to opt in to the EFSEC review and certification process must instead receive applicable state and local agency development and environmental permits for their projects directly from each agency.

This analysis was prepared by non-partisan legislative staff for the use of legislative members in their deliberations. This analysis is not part of the legislation nor does it constitute a statement of legislative intent.

Projects of Statewide Significance.
Since 1997 a process has existed to support the development of certain types of industrial projects of statewide significance. To qualify for designation as a project of statewide significance, a project must meet capital investment or job creation requirements. Possible designations include: (1) border-crossing projects; (2) private projects investing in manufacturing, research, and development; (3) projects that will provide a net environmental benefit; and (4) projects that will further commercialization of an innovation. The Legislature has designated certain types of projects as projects of statewide significance; for all other types of projects, an application for designation as a project of statewide significance must be submitted to the Department of Commerce. The application must include a letter of approval from jurisdictions where a project is located and must commit to providing the local staff necessary to expedite the completion of a project. Counties and cities with projects must enter into agreements with the Governor's Office of Regulatory Innovation and Assistance (ORIA) and local project managers to expedite the processes necessary for the design and construction of projects. The ORIA must provide facilitation and coordination services to expedite completion of industrial projects of statewide significance. The project proponents may provide the funding necessary for the local jurisdiction to hire the staff required to expedite the process.

State Environmental Policy Act.
The State Environmental Policy Act (SEPA) establishes a review process for state and local governments to identify environmental impacts that may result from governmental decisions, such as the issuance of permits or the adoption of land use plans. The SEPA environmental review process involves a project proponent or the lead agency completing an environmental checklist to identify and evaluate probable environmental impacts. If an initial review of the checklist and supporting documents results in a determination that the government decision has a probable significant adverse environmental impact, known as a threshold determination, the proposal must undergo a more comprehensive environmental analysis in the form of an environmental impact statement (EIS). If the SEPA review process identifies significant adverse environmental impacts, the lead agency may deny a government decision or may require mitigation for identified environmental impacts.

Under SEPA rules adopted by the Department of Ecology (Ecology), after the submission of an environmental checklist and prior to a lead agency's threshold determination, an applicant may ask the lead agency to indicate whether it is considering a determination of significance. If the lead agency indicates that a determination of significance is likely, the applicant may clarify or change features of the proposal to mitigate the impacts which led the agency to consider a determination of significance to be the likely threshold determination. If an applicant revises the environmental checklist as necessary to describe the clarifications or changes, the lead agency must make its threshold determination based on the changed or clarified proposal.

Lead agencies undertaking SEPA review must aspire to finish an EIS as expeditiously as possible without compromising the integrity of the analysis. For complex government

decisions, the lead agency must aspire to finish an EIS within 24 months of making a threshold determination that an EIS is needed; for government decisions with narrower and more easily identifiable environmental impacts, the lead agency must aspire to finish in far less time than 24 months. The aspirational time limit does not create civil liability or a new cause of action against a lead agency. Ecology must submit a report to the Legislature every two years on recent EISs.

Under SEPA rules, when a lead agency prepares an EIS on a nonproject proposal, the lead agency has less detailed information available on environmental impacts and the environmental impacts of any subsequent project proposals that may follow the EIS. The lead agency's nonproject EIS must discuss impacts and alternatives in the level of detail appropriate to the scope of the proposal and the level of planning for the proposal. If a specific geographic area is the focus of a nonproject EIS, site specific analyses are not required but may be included for specific areas of concern. After the approval of a nonproject EIS by the lead agency based on the EIS assessing the proposal's broad impacts, when a project is proposed that is consistent with the approved nonproject action that was the subject of the nonproject EIS, the EIS for the project proposal must focus on the impacts and alternatives, including mitigation measures, that are specific to the subsequent project and that were not analyzed in the nonproject EIS. Procedures allow for the adoption and use of portions of the nonproject EIS in a subsequent project-level SEPA review. Lead agencies must, at the time of project-level SEPA review, evaluate the nonproject EIS that was previously completed to ensure that the nonproject analysis is valid when applied to the current proposal, knowledge, and technology. If a nonproject EIS's analysis is no longer valid, the analysis must be reanalyzed in the project-level EIS.

Local Project Review.
Counties and cities planning under the Growth Management Act (GMA) are required to establish an integrated and consolidated development permit process for all projects involving two or more permits and to provide for no more than one open record hearing and one closed record appeal. Other jurisdictions may incorporate some or all of the integrated and consolidated development permit process. The permit process must include a determination of completeness of the project application within 28 days of submission. A project permit application is determined to be complete when it meets the local procedural submission requirements even if additional information is needed because of subsequent project modifications. Within 14 days of receiving requested additional information, the local government must notify the applicant whether the application is deemed complete. The determination of completeness does not preclude the local government from requesting additional information if new information is required or substantial project changes occur. A project permit application is deemed complete if the GMA jurisdiction does not provide the determination within the required time period.

Summary:

Interagency Clean Energy Siting Coordinating Council.

An Interagency Clean Energy Siting Coordinating Council (Coordinating Council) is created, and is co-chaired and co-staffed by the Department of Ecology (Ecology) and the Department of Commerce (Commerce). The Coordinating Council must have participation from at least 11 named state agencies or offices in addition to Ecology and Commerce. The Coordinating Council's responsibilities are enumerated and include:

- identifying actions to improve the siting and permitting of clean energy projects;
- tracking federal government efforts;
- soliciting input from parties with interests in clean energy project siting and permitting; and
- supporting the creation and annual update of a list to be published by the Governor's Office of Indian Affairs containing contacts at federally recognized Indian tribes, applicable tribal laws on consultation, and tribal preferences regarding clean energy project siting and outreach.

The Coordinating Council must provide annual updates to the Governor and the Legislature.

The Coordinating Council must advise Commerce in contracting for an independent third party to evaluate state agency siting and permitting processes, identify successful models used in other states for siting and permitting clean energy projects, and make recommendations for improvements by July 1, 2024. The Coordinating Council, led by Ecology, must also pursue development of a consolidated clean energy application and must explore development of a consolidated permit for clean energy projects. Ecology must update the Legislature on the consolidated clean energy application and the consolidated permit by the second half of 2024.

Clean Energy Projects of Statewide Significance.
Commerce must establish an application process for the designation of Clean Energy Projects of Statewide Significance (CEPSS). The CEPSS process contains similar elements to the existing Projects of Statewide Significance process, but is independent of that process. Applicants must demonstrate certain information to Commerce as part of the CEPSS application, including an explanation of how the project will contribute to the state's achievement of state greenhouse gas emission limits and be consistent with the state energy strategy, how the product will contribute to the state's economic development goals, and a plan for meaningful engagement and information sharing with potentially affected federally recognized Indian tribes.

The clean energy projects eligible for designation as a CEPSS include:

- certain types of clean energy product manufacturing facilities;
- electrical transmission facilities that don't primarily or solely serve fossil fuel electric generation facilities;
- facilities that produce electric generation from renewable resources or that do not result in greenhouse gas emissions, with the exception of certain hydroelectric facilities;
- storage facilities;

- facilities and projects at any facilities that exclusively or primarily process biogenic feedstocks into biofuel;
- biomass energy facilities;
- facilities or projects at any facilities that exclusively or primarily process alternative jet fuel that has 40 percent lower greenhouse gas emissions than conventional jet fuel;
- projects or facility upgrades undertaken by emissions-intensive trade exposed industries classified under the Climate Commitment Act (CCA) to align with the CCA's cap trajectory, where a project does not degrade local air quality; and
- storage, transmission, handling, or other related and supported facilities associated with any of the above facilities.

Commerce must determine within 60 business days of receipt of a complete application whether to designate a clean energy project as a CEPSS, taking into consideration criteria including the applicant's need for coordinated state assistance, whether a nonproject environmental review process or least-conflict siting process has been carried out in the project's area, and the potential impacts on environmental and public health. Commerce may designate an unlimited number of CEPSS.

The Coordinated Permit Process Available to Clean Energy Projects.
Ecology is given certain responsibilities for coordinating a fully coordinated permitting process for clean energy projects. The coordinated permitting process serves as an option, but not a requirement, for those seeking permits for clean energy projects.

Upon request, Ecology must conduct an initial assessment of a clean energy project to determine the level of coordination needed and the complexity, size, and need for assistance of the project, including specified permitting and environmental review processes. Ecology's initial assessment must be documented in writing, made available to the public, and completed within 60 days of the request for the initial assessment.

A clean energy project proponent may request that Ecology convene a fully coordinated permit process. A clean energy project proponent must provide specified information and enter into a cost reimbursement agreement with Ecology to cover the costs to Ecology and other agencies in carrying out the coordinated permit process. To convene the coordinated permit process, Ecology must determine that the clean energy project raises complex coordination, permit processing, or substantive review issues. Ecology serves as the main point of contact for the project proponent and participating agencies, and keeps a schedule identifying procedural steps in the permitting process and highlighting substantive issues that require resolution. A project proponent may withdraw from the coordinated permit process.

Within 30 days of accepting a project for the coordinated permit process, Ecology must convene a work plan meeting to develop a coordinated permit process schedule with the project proponent, local government, and participating permit agencies. Each participating agency and the lead agency under the State Environmental Policy Act (SEPA) must send

representatives to the work plan meeting, and relevant federal agencies and potentially affected federally recognized Indian tribes must be notified and invited to participate. Any accelerated time periods for permits or SEPA review under the coordinated permit process schedule must be consistent with statute, rules, regulations, or adopted state policies, standards, and guidelines for public participation and the participation of other agencies and federally recognized Indian tribes. The coordinated permit process schedule must be finalized and made available to the public after the work plan meeting.

Cities and counties with development projects determined as eligible for the coordinated permit process within their jurisdictions must enter into an agreement with Ecology or project proponents for expediting the completion of projects, including expedited permit processing and environmental review processing.

Following specified procedures, Ecology must offer early, meaningful, and individual consultation with any affected federally recognized Indian tribe on a clean energy project participating in the coordinated permit process. Ecology must identify overburdened communities that might be potentially affected by the clean energy project and verify that these communities have been meaningfully engaged in the regulatory processes in a timely manner by participating agencies.

Applicants using the fully coordinated permit process are not eligible to apply for site certification under the Energy Facility Site Evaluation Council (EFSEC) process unless a substantial change is made to the proposed project.

The CEPSS designation and coordinated permit process does not affect the jurisdiction of the EFSEC, limit or abridge the powers of a participating permit agency, or prohibit a state agency, local government, federally recognized Indian tribe, or CEPSS applicant or project proponent from entering into nondisclosure agreements related to confidential proprietary information.

State Environmental Policy Act for Clean Energy Projects.
A number of new provisions are added to SEPA that apply to clean energy project proposals:

- In addition to the 24 month aspirational timeline that applies to all SEPA environmental impact statements (EISs), lead agencies are directed to complete an EIS for a clean energy project within 24 months of a threshold determination. Lead agencies may work with a project applicant to set or extend a time limit longer than 24 months. Lead agencies must work collaboratively with agencies that have actions requiring SEPA review for a clean energy project to develop a schedule that includes a list of agency responsibilities, actions, and deadlines. Failure to comply with the SEPA timeline requirements is not subject to appeal, does not invalidate SEPA review, and does not create civil liability or create a new cause of action.
- Lead agencies may not combine the evaluation of a clean energy project proposal with other proposals unless the proposals are closely related or the applicant agrees to

a combined SEPA review. Lead agencies may require mitigation measures for clean energy projects only to address the environmental impacts that are attributable to and caused by a proposal.
- After submitting an environmental checklist, but prior to a threshold determination, a lead agency must notify a clean energy project applicant that a project proposal is likely to result in a determination of significance. The lead agency must provide the project applicant the option of withdrawing or revising the application, and must use any revised application as the basis for the threshold determination.

Ecology must prepare three nonproject EISs: one for solar energy projects, one for onshore wind energy projects, and one for green electrolytic or renewable hydrogen projects. Each nonproject EIS must include analysis of co-located battery storage for such hydrogen, solar, and wind projects. Ecology must include certain information in the nonproject EIS and address specified types of environmental impacts, and determine the EIS's scope based on input from specified parties. Ecology must offer early and meaningful consultation on the nonproject EIS's with any affected federally recognized Indian tribe. The nonproject EISs must result in the development of maps identifying probable significant adverse environmental impacts for evaluated resources. Following the completion of nonproject EISs, the Coordinating Council must review the findings and make recommendations to the Legislature and the Governor on potential areas to designate as clean energy preferred zones for the technology analyzed, and any taxation, regulatory, environmental review, or other benefits that should accrue to projects in those zones. Project proponents of actions covered by these nonproject EISs must consider the impact analysis from the nonproject EIS in carrying out project-level SEPA reviews, and may rely on the nonproject EIS in specified ways when carrying out project-level SEPA review. Clean energy projects that follow the recommendations of the nonproject environmental review must be considered to have mitigated environmental impacts unless the project-specific environmental review identifies project-level adverse environmental impacts not addressed in the nonproject environmental impact review.

Other.
During a local project review of a project to construct or improve electric generation, transmission or distribution facilities, a local government may not require a project applicant to demonstrate the necessity or utility of the project, other than to require as part of the completed project application the submission of documentation required by Federal Energy Regulatory Commission or other federal agencies with regulatory authority over electric power transmission and distribution needs, or the Utilities and Transportation Commission.

A county may not prohibit the installation of wind and solar resource evaluation equipment necessary for the design and environmental planning of a renewable energy project.

The Washington State University (WSU) Energy Program must conduct a pumped storage siting process to support expanded capacity to store intermittently produced renewable

energy, with a goal of understanding issues and interests related to areas where pumped storage might be sited, and to provide useful information to developers and for subsequent SEPA reviews of environmental impacts. The WSU Energy Program must allow ample opportunity for participation by stakeholders, governments, and federally recognized Indian tribes who self-identify an interest in the process, and must complete the process by June 30, 2025. The WSU Energy Program must develop and make available a map with geographical information systems data layers highlighting areas identified through the process. The map may not include sensitive tribal information as identified by federally recognized Indian tribes and the WSU Energy Program must take precautions to prevent disclosure of any sensitive tribal information it receives.

Commerce must conduct at least three stakeholder meetings focused on certain rural clean energy impacts, with at least one in Eastern Washington and at least one in Western Washington. These stakeholder meetings must be held with rural, agriculture, natural resource management and conservation, and forestry stakeholders to gain a better understanding of the benefits and impacts of anticipated changes in the state's energy system, including the siting of facilities under the jurisdiction of the EFSEC, and to identify risks and opportunities for rural communities. Commerce must then complete a report on rural clean energy and resilience, which must consider the stakeholder consultation and must include recommendations for how to more equitably distribute costs and benefits to rural communities. The report must specifically examine the impacts of energy projects in rural areas to jobs, local tax revenue, agriculture, and tourism, and it must forecast what Washington's clean energy transition will require for energy projects in rural Washington. Commerce must complete a report on these topics by December 1, 2024.

The Joint Committee on Energy Supply and Energy Conservation is renamed the Joint Committee on Energy Supply, Energy Conservation, and Energy Resilience (Joint Committee). The Joint Committee must hold at least two meetings to consider policy and budget recommendations to reduce impacts and increase benefits of the clean energy transition for rural communities. The Joint Committee must report its findings and any recommendations to the EFSEC and the Legislature by December 1, 2024.

A severability clause is included.

Votes on Final Passage:

House	75	20	
Senate	30	18	(Senate amended)
House	78	18	(House concurred)

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Comprehensive review of energy storage systems technologies, objectives, challenges, and future trends

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ABSTRACT

Energy storage is one of the hot points of research in electrical power engineering as it is essential in power systems. It can improve power system stability, shorten energy generation environmental influence, enhance system efficiency, and also raise renewable energy source penetrations. This paper presents a comprehensive review of the most popular energy storage systems including electrical energy storage systems, electrochemical energy storage systems, mechanical energy storage systems, thermal energy storage systems, and chemical energy storage systems. More than 350 recognized published papers are handled to achieve this goal, and only 272 selected papers are introduced in this work. A comparison between each form of energy storage systems based on capacity, lifetime, capital cost, strength, weakness, and use in renewable energy systems is presented in a tabular form. Selected studies concerned with each type of energy storage system have been discussed considering challenges, energy storage devices, limitations, contribution, and the objective of each study. The integration between hybrid energy storage systems is also presented taking into account the most popular types. Hybrid energy storage system challenges and solutions introduced by published research are summarized and analyzed. A selection criteria for energy storage systems is presented to support the decision-makers in selecting the most appropriate energy storage device for their application. For enormous scale power and highly energetic storage applications, such as bulk energy, auxiliary, and transmission infrastructure services, pumped hydro storage and compressed air energy storage are currently suitable. Battery, flywheel energy storage, super capacitor, and superconducting magnetic energy storage are technically feasible for use in distribution networks. With an energy density of 620 kWh/m3, Li-ion batteries appear to be highly capable technologies for enhanced energy storage implementation in the built environment. Nonetheless, lead-acid batteries continue to offer the finest balance between price and performance because Li-ion batteries are still somewhat costly. The applications of energy storage systems have been reviewed in the last section of this paper including general applications, energy utility applications, renewable energy utilization, buildings and communities, and transportation. Finally, recent developments in energy storage systems and some associated research avenues have been discussed. Academics and engineers interested in energy storage strategies might refer to this review.

1. Introduction

In the past few decades, electricity production depended on fossil fuels due to their reliability and efficiency [1]. Fossil fuels have many effects on the environment and directly affect the economy as their prices increase continuously due to their consumption which is assumed to double in 2050 and three times by 2100 [6]. Fig. 1 shows the current global installed capacity of energy storage system ESS. China, Japan, and the United States are among the most used countries for energy storage systems. RESs are eco-friendly, easy to evolve, and can be applied in all fields like commercial, residential, agricultural, and industrial [2]. Many problems are accomplished with applying the RESs, such as intermittency, poor load following, and non-dispatchable. Using an energy storage system (ESS) is crucial to overcome the limitation of using renewable energy sources RESs. ESS can help in voltage regulation, power quality improvement, and power variation regulation with ancillary services [3]. The use of energy storage sources is of great importance. Firstly, it reduces electricity use, as energy is stored during off-peak times and used during on-peak times. Thus improving the efficiency and reliability of the system. Secondly, it reduces the amount of carbon emitted. Thirdly, these systems are used to supply energy to

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List of abbreviations

ESS	Energy Storage System
RESs	Renewable Energy Sources
SMES	Superconducting Magnetic Energy Storage
CAES	Compressed Air Energy Storage
FES	Flywheel Energy Storage
PHES	Pumped Hydro Energy Storage
BESS	Battery Energy Stotage System
HESS	Hybrid Energy Storage Systems
EESS	Electeical Energy Storage System
ECESS	Electrochemical Energy Storage System
MESS	Mechenical Energy Storage System
TESS	Thermal Energy Storage System
CESS	Chemical Energy Storage System
SCs	Supercapacitors
EV	Electric Vehicle
BEV	Battery Electric Vehicle
HEV	Hybrid Electric Vehicle
PEV	Plug-in hybrid Electric Vehicle
FB	Flow Battery
DOD	Depth of Discharge
Li-Ion battery	Lithium-ion battery
NiCd	Nickel - cadmium battery
NaS	Sodium Sulfur battery
LAES	Liquid Air Energy Storage
SHSS	Sensible heat storage systems
LHSS	Latent heat storage system
TCESS	Thermo chemical energy storage systems
FC	Fuel Cell

consumers in remote areas far away from the grid as well as reduce the intermittency of renewable energy [4,5], and [6]. Energy can be stored in many forms, such as thermal, mechanical, chemical, or electrochemical energy. Besides, it can be stored in electric and magnetic fields resulting in many types of storing devices such as superconducting magnetic energy storage (SMES), flow batteries, supercapacitors, compressed air energy storage (CAES), flywheel energy storage (FES), and pumped hydro storage (PHS) 96 % of the global amplitude of energy storage capacity is shared by the PHS. Super-capacitor energy storage, battery energy storage, and flywheel energy storage have the advantages of strong climbing ability, flexible power output, fast response speed, and strong plasticity [7]. More development is needed for electromechanical storage coming from batteries and flywheels [8].

With the rapid rising of the development of ESS and due to the enormous energy storage potential, all the efforts of researchers are focusing on giving reviews on the types, characteristics, advantages, limitations, comparison, electrical vehicle, evaluations, challenges, and applications of ESS. Some reviews are discussed, presented and compared with our work in a tabular form in Table 1.

Table 1 revealed that no review had included every one of the previously listed points. For this reason, this review has included new developments in energy storage systems together with all of the previously mentioned factors. Statistical analysis is done using statistical data from the "Web of Science". The number of papers with the theme "Energy storage" over the past 20 years (2002–2022) is shown in Fig. 2 and it is deduced from it that ESS is a hot research field with extensive attention (see Fig. 3).

Figures (4-9) show the number of published papers and number of citations that interested in ESS technologies using the keywords (thermal energy storage system, pumped hydro energy storage, supercapacitors, SMES and battery) over the last 17 years. As can be observed in Figs. 4 and 8, there are also a lot of studies on thermal and battery energy storage, which is a hot spot of ESS and suggests that the authors are more interested in these. Furthermore, the number of papers reviewing ESS keeps rising each year, showing that ESS is a popular area of research that is receiving a lot of attention. For more clarification review, all figures have been merged in to one figure (Fig. 9). It can be observed that the number of research in ESS technologies continues to increase in the last 17 years.

In this paper, different types of energy storge are presented. Various ESS features, advantages, and limitations are discussed. In addition to, hybrid energy storage systems and some of its combinations are listed here. Furthermore, several applications of ESS along with challenges and new trends in ESS are critically reviewed.

The rest of this paper is as follows, section 2 discusses the different types of ESS, their operation, characteristics, advantages, limitations and applications. Hybrid energy storage systems in addition to several typical HESS combinations are presented in section 3. In section 4, the challenges for integrating ESS is discussed. The selection criteria for ESS is listed in section 5. Furthermore, in section 6, the applications of ESS are presented. Section 7 discusses new trends in ESS. Finally, conclusion inferred from this review paper and recommendatios are listed in section

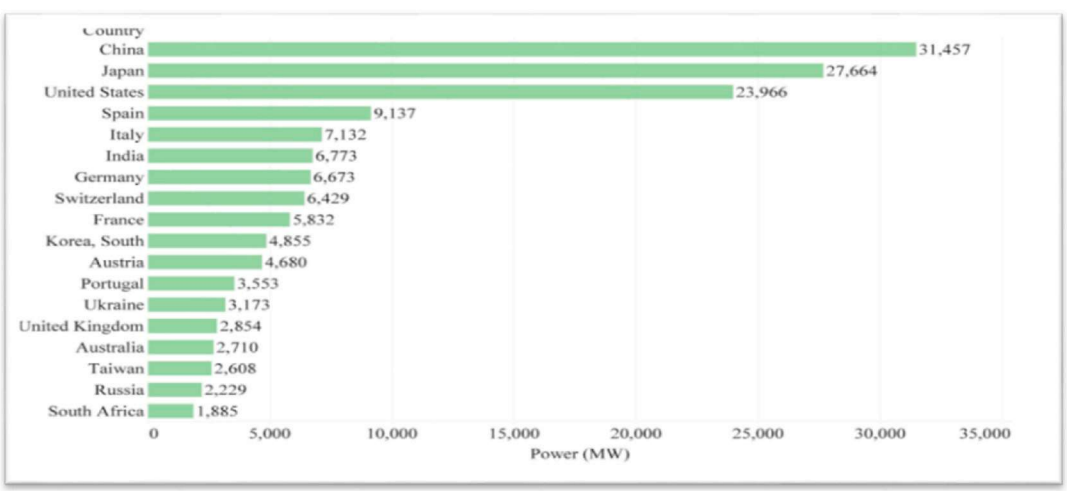


Fig. 1. Global scenario of energy storage adoption [7].

Table 1
Some reviews focusing on storage energy.

Ref.	Types	Advantages	Limitations	Comparison	Electrical vehicle	Selecting criteria	Applications	Challenges
[1]	✓	✓	✓	×	×	×	×	×
[2]	✓	✓	✓	✓	×	✓	✓	×
[9]	✓	✓	✓	×	×	×	×	×
[10]	✓	✓	✓	✓	×	✓	✓	✓
[11]	✓	✓	✓	✓	×	✓	×	✓
[8]	✓	✓	✓	×	×	×	✓	×
[12]	✓	✓	✓	✓	×	×	×	✓
[13]	×	×	×	✓	×	×	×	✓
[14]	✓	✓	✓	✓	×	✓	×	×
[15]	✓	✓	✓	✓	×	✓	✓	×
[16]	✓	✓	✓	✓	×	✓	✓	✓
[17]	✓	✓	✓	✓	×	✓	✓	×
[18]	✓	✓	✓	✓	✓	×	✓	✓
Our work	✓	✓	✓	✓	✓	✓	✓	✓

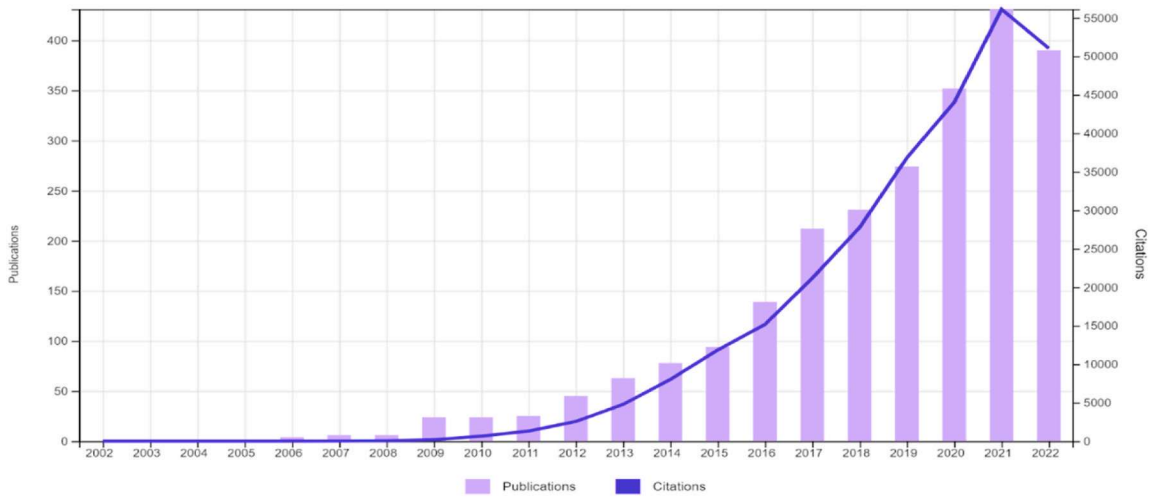
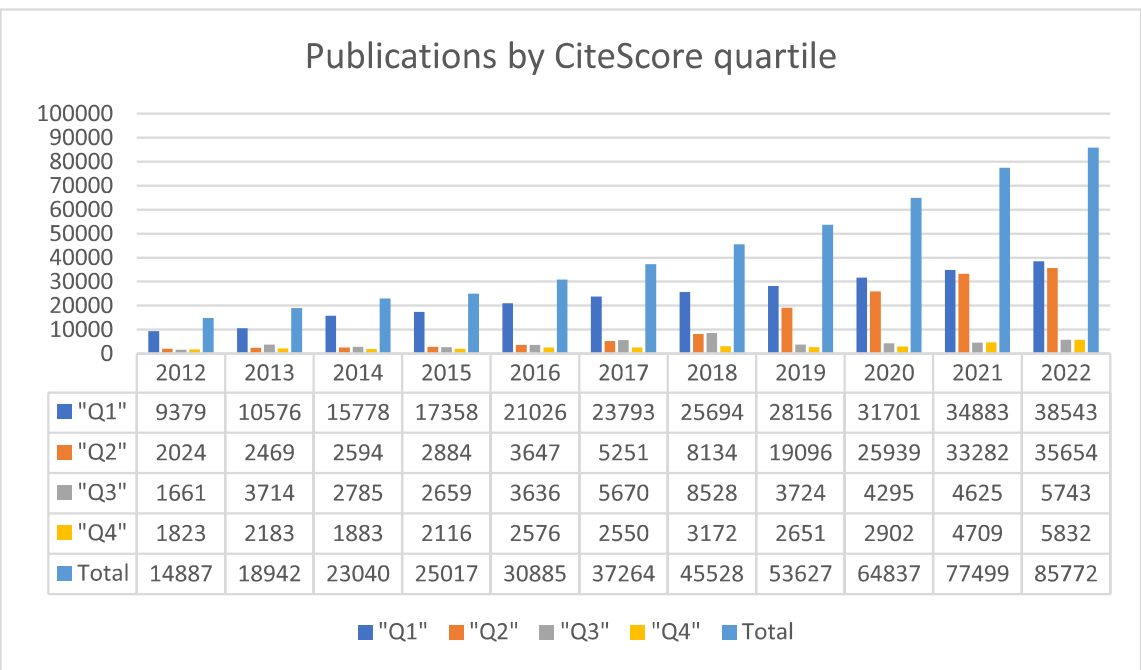


Fig. 2. Number of articles and citations reviewing ESS over the last 20 years.



	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
"Q1"	9379	10576	15778	17358	21026	23793	25694	28156	31701	34883	38543
"Q2"	2024	2469	2594	2884	3647	5251	8134	19096	25939	33282	35654
"Q3"	1661	3714	2785	2659	3636	5670	8528	3724	4295	4625	5743
"Q4"	1823	2183	1883	2116	2576	2550	3172	2651	2902	4709	5832
Total	14887	18942	23040	25017	30885	37264	45528	53627	64837	77499	85772

Fig. 3. Publications by CiteScore quartile from Scival.

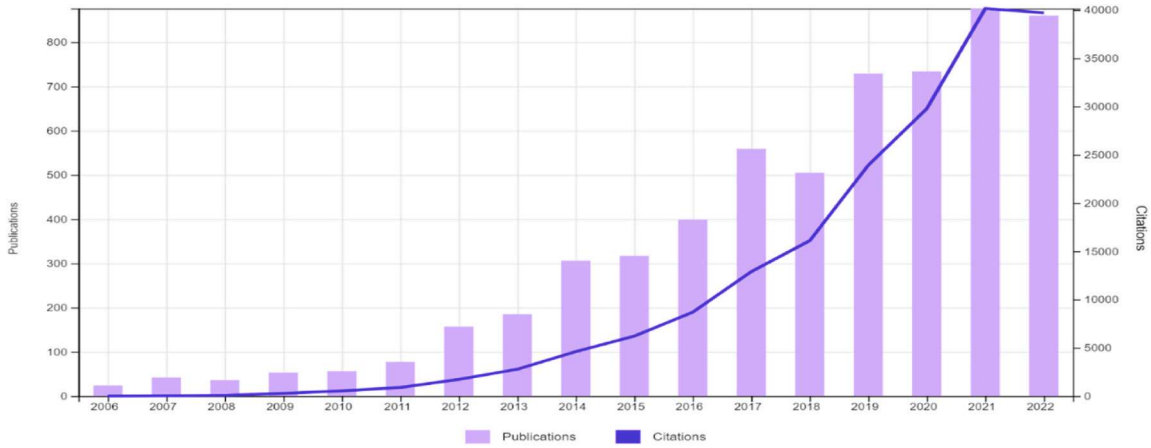


Fig. 4. Number of articles reviewing TESS over the last 17 years.

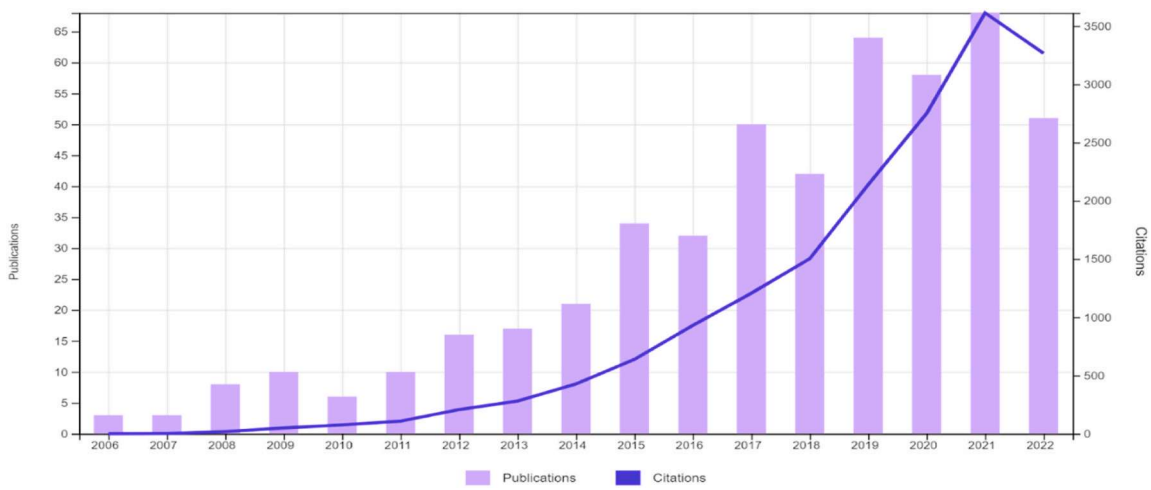


Fig. 5. Number of articles reviewing hydropower over the last 17 years.

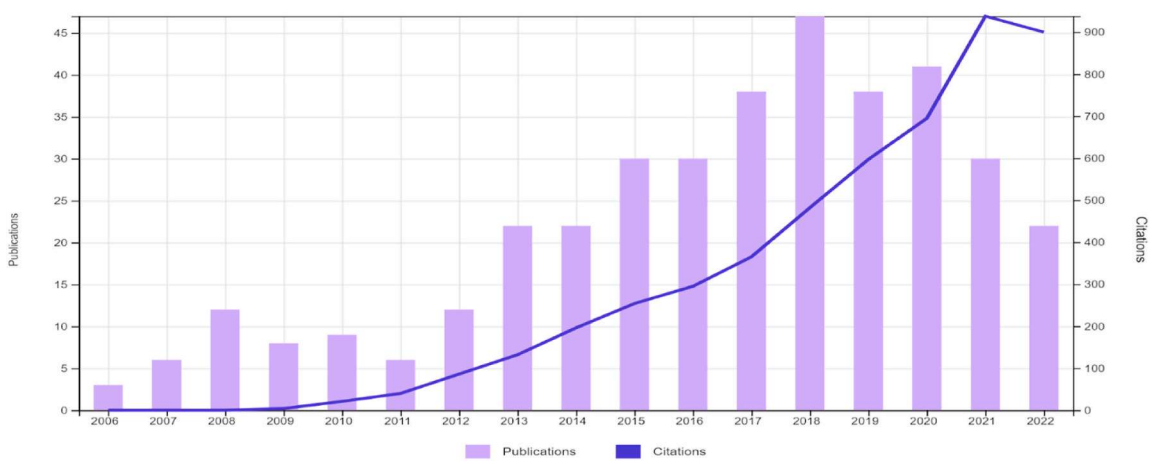


Fig. 6. Number of articles reviewing Super capacitors over the last 17 years.

8.

2. Types of energy storage

Energy storage technologies can be categorized based on the stored energy form (as shown in Fig. 10) to Ref. [9].

1. Electric energy storage systems EESS
2. Electrochemical energy storage systems ECESS
3. Mechanical energy storage systems MESS
4. Thermal energy storage systems TESS
5. Chemical energy storage systems CESS

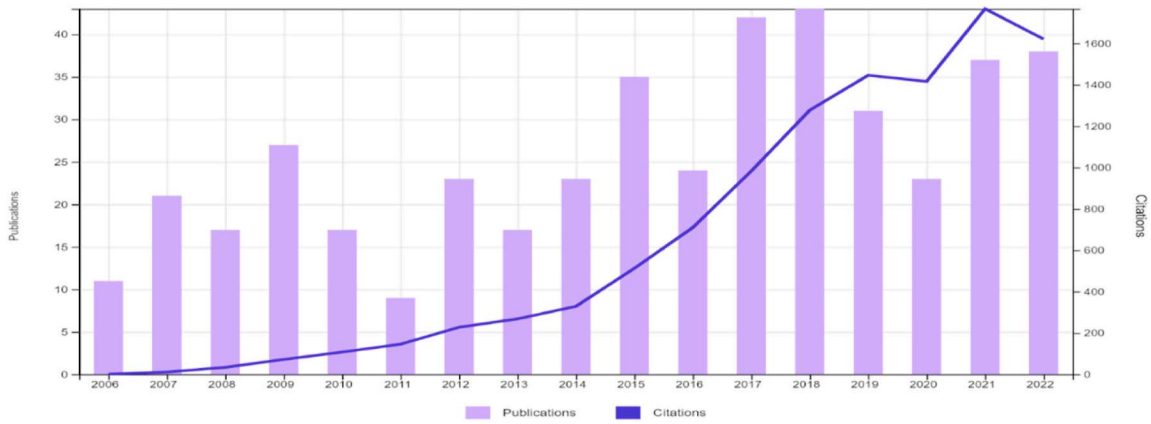


Fig. 7. Number of articles reviewing SMES over the last 17 years.

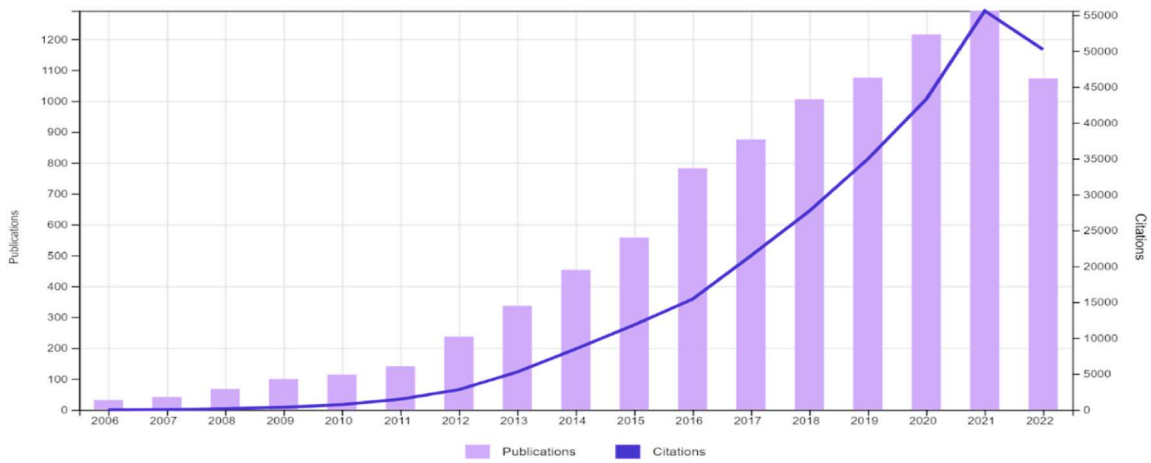
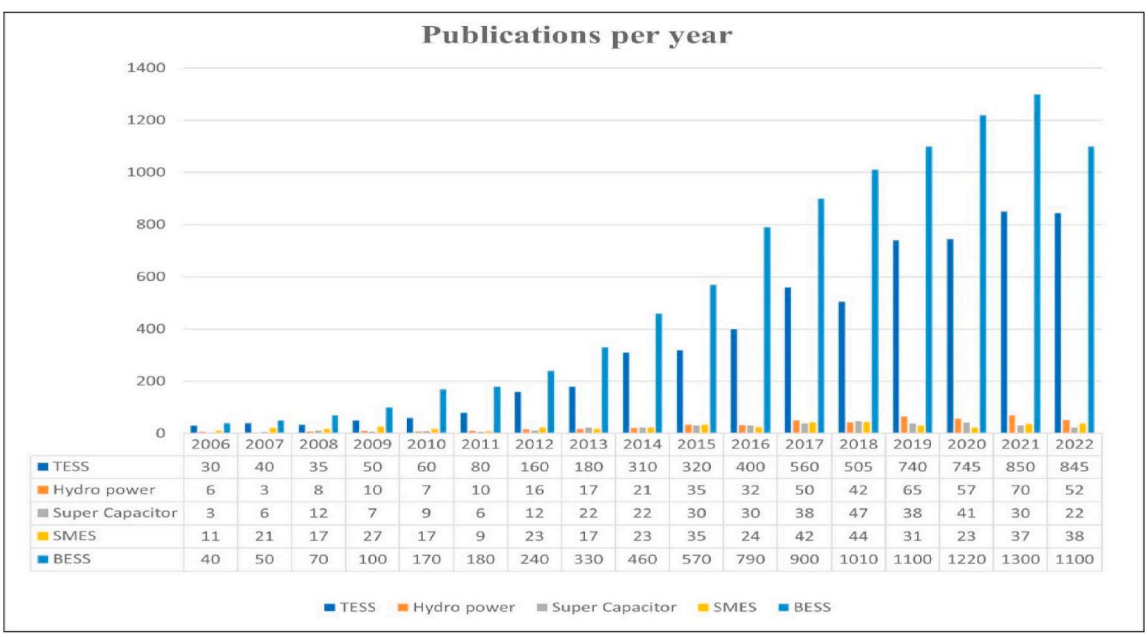


Fig. 8. Number of articles reviewing battery energy storage system BESS over the last 17 years.



	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
TESS	30	40	35	50	60	80	160	180	310	320	400	560	505	740	745	850	845
Hydro power	6	3	8	10	7	10	16	17	21	35	32	50	42	65	57	70	52
Super Capacitor	3	6	12	7	9	6	12	22	22	30	30	38	47	38	41	30	22
SMES	11	21	17	27	17	9	23	17	23	35	24	42	44	31	23	37	38
BESS	40	50	70	100	170	180	240	330	460	570	790	900	1010	1100	1220	1300	1100

Fig. 9. survey of ess growth technology over the last 17 years.

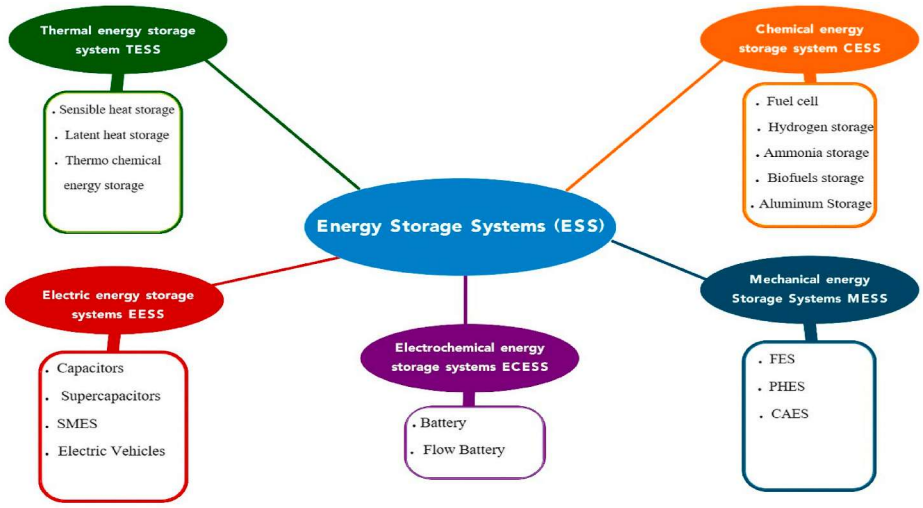


Fig. 10. Classification of energy storage technologies.

2.1. Electric energy storage systems (EESS)

It can be categorized to electrostatic and magnetic systems. The capacitor and the supercapacitor are electrostatic systems while the SMESS is a magnetic system [9].

2.1.1. Capacitors (Cs)

Two metal plates called electrodes separated by dielectric layer form the electric capacitor. One plate is charged while the other plate is induced by an opposite sign charge [19]. The energy is stored on the surface of the metal electrodes. This type storeenergy for extremely short periods [12]. Fig. 11 shows a schematic diagram for a capacitor. Plates size the distance between plates and the dielectric material are the factors affecting the capacitor energy capacity [14]. The capacitors are suitable for small scale power applications as they have an instant recharge capabilities and long lift cycle. For large scale applications, it will be very expensive [7].

2.1.2. Supercapacitors (SCs)

To conquer the problems mentioned above of the capacitors, the supercapacitors or ultracapacitors are patented by the Japanese company Nippon Electric Company in 1975 [20]. Compared with conventional capacitors, supercapacitors have very high output power of (50–100 KW), high charge density, life likelihood of 12 years, 500,000 times life cycle and high self-discharge [15]. Therefore, SC are suitable for application which required instant high output power like engine cranking applications of hybrid vehicles and permanent magnet synchronous generator. SCs and Cs have identical operating principles. Despite, in SC, electrolytic physical barrier comprising of activated carbon is used as a dielectric which allows ionic conduction, and this assists the SC to have large specific area and so high energy density [21]. The other difference is in the electrode materials, SCs use carbon nano

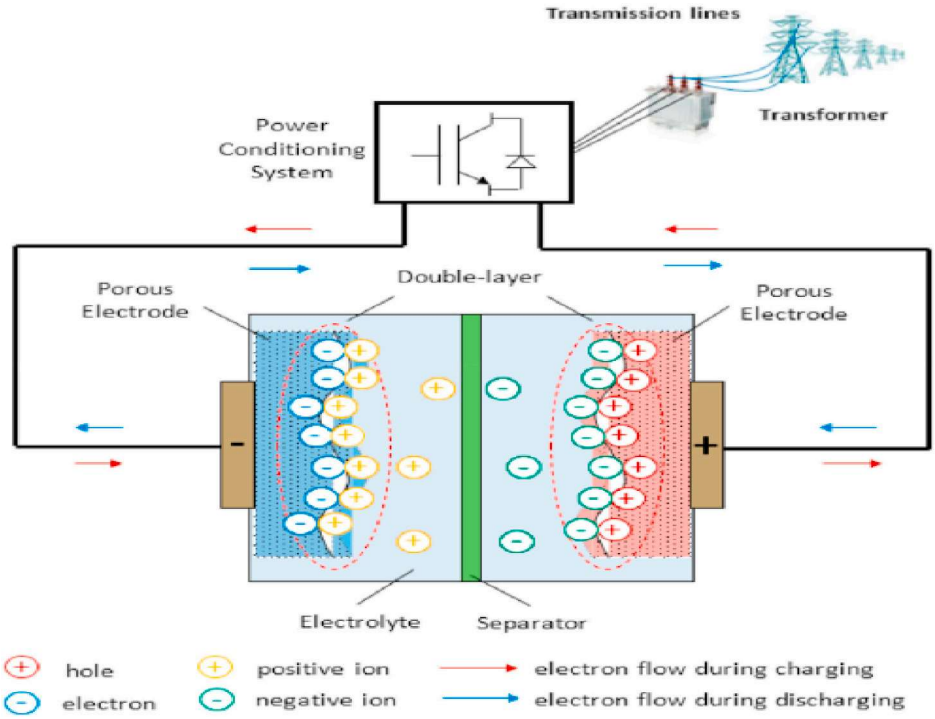


Fig. 11. Schematic diagram for a capacitor [11].

tube electrode which provide a tiny splitting up distance and a huge amount of charge is absorbed and hence improving the energy density [21]. Applying the electric field, the electrolyte performs as a dielectric and an ion absorption layer is generated on the activated carbon fibers [21]. The charging and discharging occur on this ion absorption layer. The schematic of supercapacitor is represented in Fig. 12. Many papers have been published about SC applications and to upgrade its control strategy.

2.1.3. Superconducting magnetic energy storage (SMES)

SMES can be made up of a superconducting coil which has no electrical resistance near absolute zero temperature that can store electric energy in the form of magnetic field created by DC current passing through it and there is no energy loss in the coil. The second part of SMES is cryogenically cooled refrigerator which keep the coil at a cryogenic temperature by utilizing liquid helium or nitrogen and therefore there is some energy losses (about 2–3% of energy) is lost related with cooling system [2]. The third part of SMES is a power conditioning system to convert the stored energy to an AC power [9]. The coils temperature must be below its critical temperature. The schematic diagram of a SMES is shown in Fig. 13.

SMES has very long lifespans (30 years), cycle life, high efficiency (95–98 %), short time for complete discharge (less than 1 min), fast response speed, very low power loss, high power density, and very high discharge rates [16,17,22,23]. During discharging, the SMES can provide huge amount of energy to the grid during a break of a second (milliseconds) [12].

The major drawbacks of SMES units are the performance problems due to the strong magnetic field, high cooling demand, high-priced raw materials, complex design, high capital cost ($104/kWh), high self-discharge rate (10–15 %/day), temperature sensitivity and pricy in operation [24,25].

Current curiosity in SMES is because of the capability to operate microgrids on the residential and utility scale [27]. The research fields of SMES are mainly focused on reducing the cost of superconducting coils and liquid nitrogen cooling systems; and developing high-temperature superconducting coil (HTS) materials with lower low-temperature sensitivity (working at around 70 K) and capital cost [18,44]. SMES applications include load leveling, system stability, voltage stability, frequency regulation, transmission capability enhancement, power quality improvement, automatic generation control, and uninterruptible power supplies [2,28].Accordinr to Refs. [7,9,29], and [30], Table 2 has been derived including different characteristics of EES devices.

2.1.4. Electric vehicles (EVs)

Electric vehicles use electric energy to drive a vehicle and to operate electrical appliances in the vehicle [31]. The spread of electric vehicles, commonly known as zero-emissions vehicles, will gradually replace

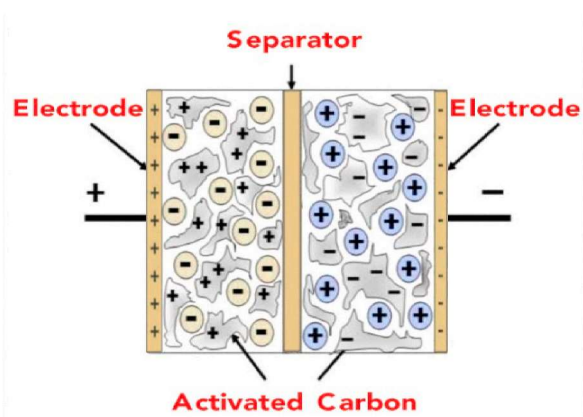


Fig. 12. Schematic diagram of an individual cell of a SC.

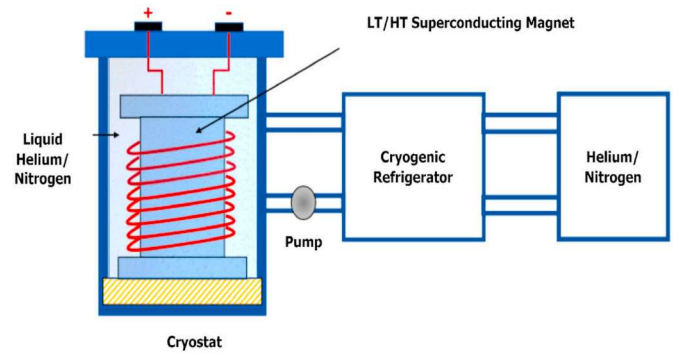


Fig. 13. Superconducting magnetic energy storage [26].

older fuel vehicles and enormously reduce greenhouse gas emissions [18]. There are many technologies that can be utilized in EV such as SC, batteries, FC, or hybrid ESS [32] as shown in Fig. 14. EV can be categorized in to hybrid EVs (HEV), battery powered EVs (BEV), plug-in hybrid EVs (PEV), photovoltaic EVs (PEV), and fuel cell EVs (FCEV) [33]. The major barriers of EVs are that the charging is not fast enough and charging facilities are not highly accessible in most cities and the cost is disproportionate, roughly 1/3 of the cost of EV is employed for the ESS technology on the car [18]. Table .3 summeriezes the characteristics of different types of EVs.

2.1.4.1. Battery electric vehicle (BEV). BEV or "pure electric vehicles" as there is no fuel tank and the electricity is totally served by the battery [34]. It is comprised of a huge rechargeable battery. This battery is charged from the grid or any external source using a charging plug [36]. BEVs charging takes roughly 6–8 h for slow charging and 20–40 min with a fast charger [37]. For the fully charged battery, BEV tracks 100 km–250 km distance [38]. BEVs are appropriate for short distances. Battery temperature affects the performance of the battery and life cycle [39]. The BEV storage capacity is above 100 kWh [35]. Due to this substantial reserve capacity, it is used for minimizing renewable energy fluctuations and stabilizing the voltage and frequency of the grid [40]. The illustrative structure of BEV is presented in Fig. 15. The improved version of BEV such as HEV and PHEV are discussed to increase the covered distances.

2.1.4.2. Hybrid electric vehicle (HEV). HEV is a combination of two or more types of energy and power sources. Power source like battery, fuel cell FC, SC, internal combustion engine (ICE), and energy source like battery, FES, or regenerative braking [34] are used for combining the profits of ICEVs and EVs [41]. Available hybrid powertrain configurations have been described, categorized, and totally analyzed in previous literature reviews [42–44]. Energy management strategy (EMS), which copes with the power distribution between power sources according their own control guidelines, has been significantly studied with different objectives like fuel usage minimization [45,46] emission diminishing [47], and battery lifetime [48]. The profit of HEV is that when the primary fuel (diesel, gasoline) storage tank runs out of during driving the ICE then the secondary source will operate as a backup system to the driveline with its maximum range [49].

2.1.4.3. Plug-in hybrid electric vehicle (PEV). The PEV is a form of HEV in which the battery is charged from an external source. PEV can run on both battery and gasoline. These batteries can be charged at a charging station or at home using an ordinary plug or by a regenerative braking system [34]. For short distances, it uses battery banks and for long distances, it utilizes gasoline power when battery power is depleted [50]. Because of decreasing moving parts of PEV, it has lower maintenance cost. The typical configuration of PEV is presented in Fig. 16. There are two ways of working of PEV. The first one is grid to the vehicle

Table 2
Characteristics of different EES devices.

EESS	Capacity (MW)	Lifetime (Years)	Capital cost (€/kWh)	Strength	Weakness	Use in RE Systems
Capacitor	0.05	5	897	High power density	Small capacity	No use
Supercapacitor	0.3	20	1795	- High charge -Discharge efficiency (95 %) -Fast response -High efficiency -Long lifetime	-Low voltage -High self-discharge rate -High capital cost	Wind parks
SMES	0.1–10	20	8974	-High cycles of charging- discharging -High power density -Fast response -High efficiency	-High cost -High self-discharge rate -High capital cost	Wind parks

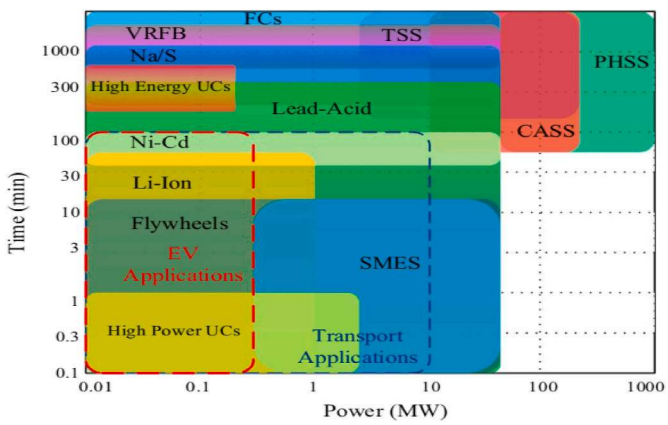


Fig. 14. Suitable technologies for EV [32].

Table 3
The characteristics of different types of EVs [34,35].

Characteristic	BEV	PHEV	FCEV
Energy system	-Battery -UC	-Battery -ICE -UC	-FC -Battery -UC
Energy source	-Charging power station	-Charging power station -Fuel pump -Gasoline	-Hydrogen fuel
Energy supply capacity	-Limited by battery -Capacity	-Limited by battery -capacity	-Unlimited
Carbon emissions	-Zero emissions	-Some emissions	-Zero emissions
Price factors	-Battery price -Market electricity -Price	-Battery price -Market electricity -Price -Gasoline price	-Battery price -Market electricity -Price - Fuel price
Advantage	-Zero emissions -Independence on fossil fuels	-Less emissions -Long-distance covered	-Zero emissions -High efficiency
Disadvantage	-High initial cost -Battery replacement	-Dependence on fossil fuels -Higher cost	-Hydrogen fuel storage -High cost of fuel
Degree of application	-Extensive use	-Being popularized	-Test stage

(G2V) whereby, the battery charges from the grid to drive the vehicle and charge the battery. The second one is the vehicle to grid (V2G) in which the battery provides power to the grid to overcome the grid overload problem [31]. In regenerative braking mode, the traction motor acts as a generator to charge the battery [51]. PEV can drive for a proper distance, but it has some drawbacks like its initial cost is higher than BEV and it produces more emissions than BEV. Owing to these reasons, BEV is obtaining more approval than PHEV [34].

2.1.4.4. EVs utilization as ESS. The market for electric vehicles (EVs) is growing quickly on a global scale. It is expected that market share will rise significantly in next few years [52]. Globally, there were more than 5 million electric vehicles (EVs) in use in 2018. It is anticipated that this number will increase rapidly to 44 million by 2030 [52]. The power system has traditionally struggled to balance generation and load demand; however, EV integration into the grid presents additional difficulties. The growing popularity of electric vehicles (EVs) presents substantial operational difficulties for the power grid since the patterns of EV charging and discharging need to be carefully controlled to maintain system stability and dependability. It is more difficult to balance the supply and demand of electricity when EV charging is dynamic and renewable energy sources are sporadic [53]. To solve these issues, numerous approaches and technologies are being developed, including as vehicle-to-grid (V2G) technology, smart charging infrastructure, and sophisticated grid management systems. These technologies allow for bidirectional power transfer between EVs and the grid, improve grid flexibility, and optimize EV charging and discharging patterns [54].

EV batteries have a fast reaction time, which makes them ideal for auxiliary functions like frequency regulation. EV batteries can play a significant role in preserving grid stability and balancing the frequency of the power system due to their quick response to variations in power supply or demand. This increases the potential value of EVs in sustaining the overall performance and dependability of the power grid and makes them a desirable alternative for providing auxiliary services [55]. To optimize EV integration benefits while preserving system stability, effective coordination between renewable energy generation, EV charging, and grid operations is essential. For EVs to be seamlessly integrated into the power grid, standards, incentives, and policies must be established in close coordination with automakers, energy providers, and regulatory agencies [56]. Some work contributions with several issues using EESS are tabulated in Table 4.

2.2. Electrochemical energy storage systems (ECESS)

ECESS converts chemical to electrical energy and vice versa [14]. ECESS are Lead acid, Nickel, Sodium –Sulfur, Lithium batteries and flow battery (FB) [9]. ECESS are considered a major competitor in energy storage applications as they need very little maintenance, have high efficiency of 70–80 %, have the greatest electrical energy storage (10 Wh/kg to 13 kW/kg) [15] and easy construction, [1]. However, there are some barriers high maintenance costs in large-scale facilities, their lifetime depend on depth-of-discharge (DoD) and relative low cycling times [9].

2.2.1. Lead acid batteries

The most heavily used rechargeable battery is the lead–acid battery [80]. They are composed of lead dioxide (PbO2) as the positive electrode and lead dioxide (PbO2) as the negative electrode immersed in an electrolyte mitigated solution of sulfuric acid (H2SO4) [81]. Lead–acid batteries have very tiny response time, little daily self-discharge rates, relatively high efficiencies, small capital costs, and can be stablished for

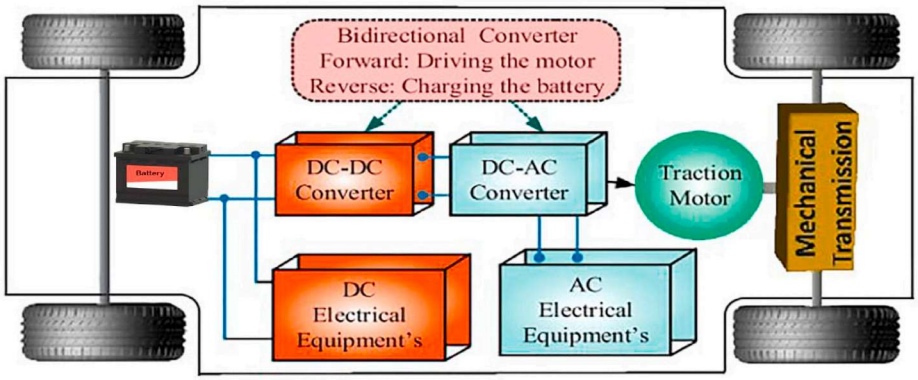


Fig. 15. typical structure of BEV.

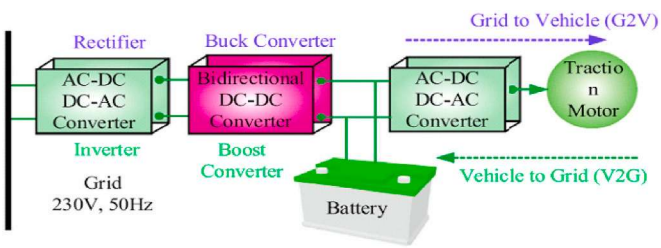


Fig. 16. Typical structure of PEV [31].

the large scale applications [82]. On the other hand, they have restricted life cycle, usually require a ventilation system, and charging and discharging process are not identical [83]. The schematic diagram for led acid batteries during charging and discharging is shown in Fig. 17.

2.2.2. Lithium-ion battery (Li-Ion battery)

This type of battery is very appropriate for portable applications such as laptops and mobile phones because of its low weight, good performance, fast response time, and high cycle effeciency. Also, It can also be used to improve the performance of EVs [12]. In a Li-Ion battery, the cathode is made of a lithium metal oxide, such as LiCoO2 and LiMO2, and the anode is made of graphitic carbon as shown in Fig. 18 [82]. The Li-Ion battery current research spotlights on using nanoscale materials for improving the power capability of the battery and heightening battery specific energy by progressing advanced electrode materials and electrolyte solutions [82].

2.2.3. Nickel - cadmium battery (NiCd)

These batteries are commercially used since about 1915. The two electrodes of these batteries are nickel hydroxide and metallic cadmium. The electrolyte is made of an aqueous alkali solution as presented in Fig. 19 [82]. NiCd batteries have low maintenance, relative high efficiencies, and the ability to work in a wide range of low temperatures (from −20 °C to −40 °C). However, they can affect the environment as cadmium and nickel are toxic heavy metals, NiCd batteries cost is up to 10 times greater than the Li-ion batteries [85]. NiCd battery can be used for large energy storage for renewable energy systems. The efficiency of NieCd battery storage depends on the technology used during their production [12].

2.2.4. Sodium sulfur battery (NaS)

In the NaS battery, molten sodium and molten sulfur compose the two electrodes and uses beta alumina as the solid electrolyte. A scheme of a NaS battery cell is shown below in Fig. 20 [82]. This battery can supply high rated capacity than other types of batteries (up to 244.8 MWh). So, it is built for high power energy storage applications [86]. This storage system has many merits like there is no self-discharge, high energy densities (150–300 Wh/L), high energy efficiency (89–92 %), low maintenance and materials cost, non-toxic materials, and materials can be recycled [87]. NaS batteries used for grid connected applications like power quality enhancing and peak shaving [85]. However, the demerits are high operating cost (80 $/kW/year) to obtain liquid electrodes, and a high temperature (574–624 K) chemical reaction is required. So, an additional system is used which adds an extra cost and it is suitable only for large scale power system applications [85]. The research mainly focuses on improving the cell performance and decreasing the high temperature operating costs [1].

2.2.5. Flow batteries (FBs)

Flow battery consists of two liquid electrolytes which stored in two dissolvable redox couples enclosed in external tanks to increase the energy storage capacity [88]. These electrolytes can be pumped from the tanks to the cell stack, and they are separated by a microscopic membrane to allow a restricted ions number to pass over it. Through the electrolyte solutions reduction oxidation reactions, the electricity is produced [89]. The flow battery schematic diagram is shown in Fig. 21. Unlike the FC, the chemical reactions taking place inside the flow batteries are reversible. So, it can be recharged without replacing the electroactive material. The FB's power rating relies upon the stacks number of the cell and the electrode size [15]. FB can release huge amount of energy at a high discharge rate and has a good life cycle (10, 000 full cycles during their lifetime) [90]. FBs have tiny response time, have high efficiency, and operate near to the ambient temperature [85]. Evaluation of various battery technologies' parameters in a comparison is presented in Table 5. In addition to, some characteristics of every type from electrochemical energy storage systems ECESS including their strength and weakness issues are presented in Table 6.

It has been noticed from Table 7 above that there are plenty of papers that concerned with challenges and limitations of batteries (Li- io battery, Na–S battery and lead acid battery). Batteries can be used in different systems as grid connected or isolated systems providing the advantages of minimizing cost (total cost, maintenance cost or investment cost), preventing voltage fluctuation in LV distribution network, maximizing PV utilization and minimizing losses. There are various optimization techniques that can be used for catching these benefits.

2.3. Mechanical energy storage system (MESS)

MES is one of the oldest forms of energy that used for a lot of applications. It can be stored easily for long periods of time. It can be easily converted into and from other energy forms [15]. Three forms of MESs are drawn up, include pumped hydro storage, compressed air energy storage systems that store potential energy, and flywheel energy storage system which stores kinetic energy.

Table 4
Challenges and limitations of EESS.

Ref	Challenge	ESS Device	Isolated/Grid connected	Limitation	Contribution
[19]	Minimize operating cost (fuel + startup cost)	SMES	Islanded	Power quality is not improved	Using the modified LR-PSO method on IEEE 10-unit thermal bus system with and without SMES
[23]	Control SMES terminal voltage	SMES	Grid connected	Power quality is not improved	A new security circuit is proposed for highly inductive loads to ensure safe operation in case of fault.
[57]	Control of SC˙SOC Minimizing Power loss	SC	Isolated	Cost is not considered	The strategy improved the reliability of the system and reduced the required communication data.
[58]	Control fluctuation of wind power	SC BESS	Grid connected	High cost	Design system composed of HESS to control wind power fluctuations by using fuzzy logic control.
[59]	Minimize cost Minimize fuel Minimize system efficiency	SC BESS	Isolated	Power quality is not improved	Design a HESS used for distributed generation system to meet the demand for a UK family and reduce the generator operating time.
[60]	Using SC to control high voltage ride through (HVRT) for wind turbine generation system.	SC	Grid connected	The overall power quality is unsatisfactory	Design a control system for wind turbine generator to control HVRT using SC.
[61]	Controlling system frequency.	SC	Grid connected	Cost is not considered	Using fuzzy logic control strategy for control frequency of DFIG, SC and wind farm system under variable wind speed.
[62]	- Control SOC of SC Minimize DC voltage fluctuation	SC	Isolated	Power quality is not improved.	EMS depends on using SOC of SC and DC voltage fluctuation as a reference to perform a double closed loop to control SC.
[63]	-Minimize DC voltage fluctuation. -Control SOC of SC.	SC	Isolated	Cost is not considered	Design a three-level bidirectional DC-DC converter to control the SC power flow. Using model predictive control to control the converter.
[64]	Optimal design of SMES system	SMES – BESS	Grid connected	Lack of ESS control	Design micro grid system with SMES integrated system of capacity 1.2 MW for a micro grid system
[65]	Reduce system cost	SMES	Grid connected	Power quality is not improved	Using an adaptive fractional-order sliding-mode control (AFOSMC) to improve the dynamic response of SMES against various operating conditions
[66]	Mitigate the fluctuations of PV output during a cloud passing.	SMES BESS	Grid connected	Cost and losses are not considered	Using HESS composed of high temperature superconducting coils based superconducting magnetic energy storage (HTS SMES) and battery for voltage control.
[44]	Voltage control of DC grids connected to wind farms	SMES	Grid connected	Cost is not considered	Design of SMES system. control system of SMES
[67]	Smoothing the output of the wind farms	SMES	Grid connected	losses are not taken into account.	Improving the wind farms transient stability using a control strategy of the SMES in parallel with voltage source inverter.
[68]	Improve the grid power quality	SMES	Grid connected	High system cost	Adding SMES in VSC based active filter for reducing THD.
[69]	Control the fluctuation of frequency due to transient load changes.	SMES	Isolated	Losses are not considered	Design the fuzzy PI controller for SMES.
[70]	Compensate voltage fluctuations for a grid connected hybrid renewable system	SMES BESS	Grid connected	Neglecting losses and cost.	Using battery and SMES based dynamic voltage resistor for compensating voltage fluctuations.
[71]	Smoothing output power for DFIG and PMSG.	SMES	Grid connected	Battery degradation is not considered	Usin transient voltage control (TVC) method to reduce the PCC˙VD and enhances the overall system performance
[72]	Design a multistage SMES	SMES	Isolated	Cost is not considered.	Design a multistage SMES and study the system performance with the conventional SMES and multistage SMES.
[73]	Optimization the SMES coil dimensions	SMES	Isolated	Power quality is not improved	Using a multi- objective function GA to minimize the coil losses.
[74]	- Increasing system efficiency - Minimizing cost	SC BESS	Isolated	Battery degradation is not considered	Design a bidirectional DC_DC converter for HESS for EV and HEV.
[75]	Control SOC of SC banks	SC BESS	Isolated	Battery degradation is not taken into account	Design a new multi-source inverter MSI for integration SC and B for EV.
[76]	-Control SOC of SC -Minimize the system cost	SC BESS	Grid connected	Power quality is not improved	Dynamic wireless power transfer WPT system for charging EV.
[77]	-Minimize system cost -Control SOC of SC	SC Li-ion Battery	Grid connected		Optimal design of EV based HESS composed of Li-ion B and SC to minimize the system cost, improve power quality, and increase the overall efficiency.
[78]	Control current and voltage of the system.	SC BESS	Isolated	Cost is not considered	Control strategy for EV based on HESS composed of SC and B to control SOC of SC and prolong battery life.
[79]	Minimize battery current ripples and SC current fluctuation.	SC li-ion Battery	Isolated	Cost is not considered	Implementation fuzzy logic on EV based on HESS

2.3.1. *Flywheel energy storage (FES)*

FES was first developed by John A. Howell in 1983 for military applications [100]. It is composed of a massive rotating cylinder which is sustained over a stator and electric motor/generator is jointed with the flywheel. In FES, kinetic energy or rotational energy is transformed to electrical energy by using electric generator on the discharging mode and vice versa on the charging mode. Permanent magnet machines are commonly used for FESs because of their high efficiencies, high power densities, and low rotor losses [101]. The FES capacity is proportional to its mass and the square of speed [9]. Its efficiency relies on the energy storage usage time. FES is not suitable for storing energy on long-term basis so, it is combined with other devices [14]. The schematic diagram of FES is presented in Fig. 22. The flywheel is kept on a low pressure state to reduce the frictional losses [10]. FES can be used for load levelling and peak shaving and reducing the RES intermittencies by supplying real power to the system when necessary [102,103]. Because of FES fast response, it can be used for enhancing system stability for penetration RES in power systems [104]. Relied on rotational speed, the FES can be classified into two categories: low-speed FES (less than 6000 rpm) and high-speed FES (about $10^4 - 10^5$ rpm) [17,21]. The low speed FES is suitable for power reliability applications, and it has low cost. High speed FES is good for traction and aerospace applications and its cost is five times larger than low speed FES [10]. FES has many merits like high power and energy density, long lifetime and lower periodic

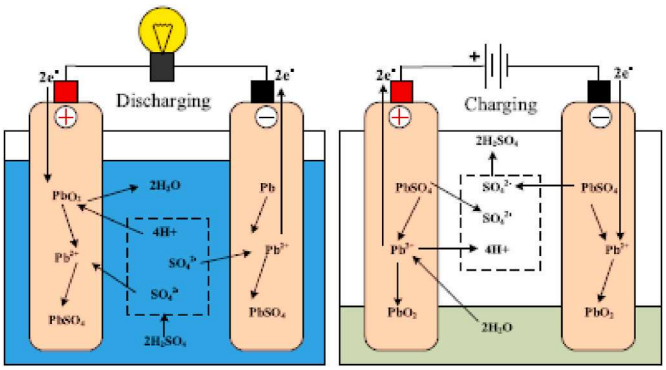


Fig. 17. Schematic diagram for lead acid batteries during charging and discharging [84].

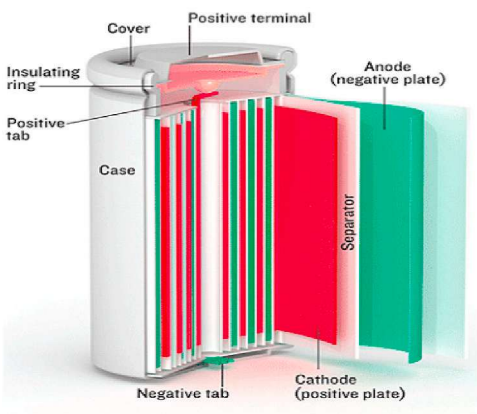


Fig. .18. Li-Ion batteries cell structure [82].

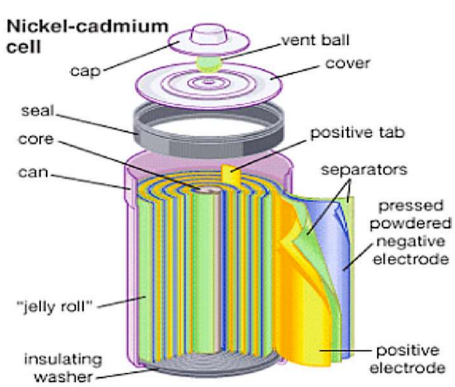


Fig. 19. Nickel–Cadmium cell [82].

maintenance, small recharge time, temperature insensitivity, 85%–90 % efficiency, high charging and discharging rate, large energy storage capacity, and clean energy. On the other hand, it has some demerits, small discharge time, intricate structure, mechanical stress, protection anxieties because of high rotor speed and breaking likelihood, and high cost [102].

2.3.2. Pump hydro energy storage (PHES)

PHES composed of two natural or manufacturing positioned/designed at higher and lower heights [14]. In Fig. 23, the components of PHES is presented which involve: upper reservoir, lower reservoir, motor, generator and inlet valve. When the electricity demand is low, the water is lifted from the inferior reservoir to the higher one and vise versa when the demand is high. The electricity is then generated from the stored water to supply power for momentary peaks or for unpredicted outages [12]. To produce a variable output power, the inlet water flow is controlled using gates and variable-speed drives can be utilized for regulation while charging [7]. PHES needs some conditions like, location existence besides difference in height [7]. PHES has many advantages such as long life time (40–60 years), fast response time, low cost, high efficiency, ability to store enormous amounts of energy, and very low self-discharge rate [103,105]. In contrast, it has some disadvantages such as it needs huge water source, massive environmental affect, and not much possible sites [103].

2.3.3. Compressed air energy storage (CAES)

CAES uses compressed and pressured air to store energy [106]. Compressor, underground storage unit, and turbine, are the main CAES components. The air is compressed and stored at a high pressure in an underground chamber and when needed, it expanded. The air is compressed while off peak and this stored energy is used during peak time. While peak time, the compressed air is fed to a combustion chamber which mixed with fuel to generate electricity [10]. The schematic of CAES plant is shown in Fig. 24. CAES and PHES are the available largest scale energy storage systems. Compared with PHES, CAES is smaller in size, its construction sites are more prevalent. So, it offers a large-scale widespread storage network [107]. It is more convenient for frequency regulation, energy arbitrage, and load levelling [15]. To enhance the CAES efficiency, the released heat from the compression stage, stored and used while expansion process and this improve the overall system efficiency by 10 %–15 % [12]. The CAES life cycle is approximately 40 years [103]. CAES has many merits like, it can store massive amount of energy, it has high efficiency 70 %, fast response, and low cost. On the other hand, it has some demerits such as, the need for enclosed storage cavern, economical for a storage period of up to one day only and not yet completely advanced [103]. The researchers focus on Liquid Air Energy Storage (LAES) as liquefied air is thick, so it is more convenient for long-term storage, Advanced Adiabatic CAES and Supercritical Compressed Air Energy Storage [108]. Some characteristics of different types of mechanical energy storage systems including their strength and weakness issues are tabulized in Table 8. Also, some papers that concerns with several issues using MESS is tabulized in Table 9.

Table 9 indicates the concerned challenges and limitations of MESS (PHES, CAES and FES). All types can be utilized for both grid connected and isolated systems. It can be concluded that all mentioned types can reduce cost and control system voltage. CAES can control both active and reactive power and the SOC. Also, PHES has the ability to smooth fluctuations of Photovoltaic Power and improve system reliability. Different optimization starategies have been applied to achieve these advantages.

2.4. Thermal energy storage systems (TESS)

Heat or cold is stored in TESS for later use. These systems consist of a heat storage tank, an energy transfer media, and a control system. Heat is stored in an insulated tank using a specific technology [12]. Utilizing these systems reduces energy consumption and overcome the problem of intermittency in renewable energy systems [82]. TESS has some advantages like, clean energy source for generating electricity, reducing heating or cooling energy demand for buildings, low initial cost, reducing emissions, increasing continuity, and reducing maintenance cost [85,121]. On the other hand, some concerns should be considered such as: increasing complexity, the overall efficiency for TESS is low (30–50 %), thermal losses, and the possible prescribed space [121]. A simplified TES diagram is presented in Fig. 25. TESS is mostly utilized for industrial, residential buildings for generating electricity besides producing water, and is often used in PV systems which guarantee collecting much amount of energy from the sun [10,12]. Thermal energy can be stored in the form of latent heat, sensible heat, and reversible

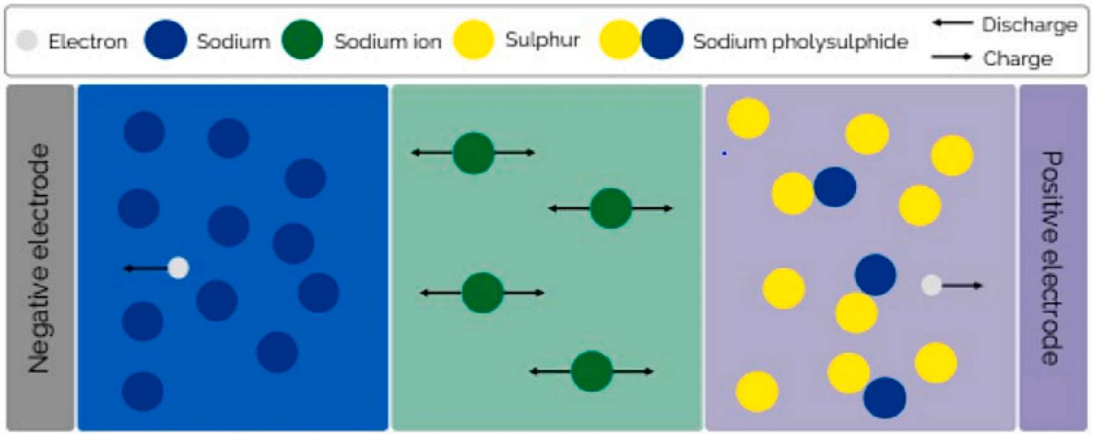


Fig. 20. Schematic diagram of NaS battery [82].

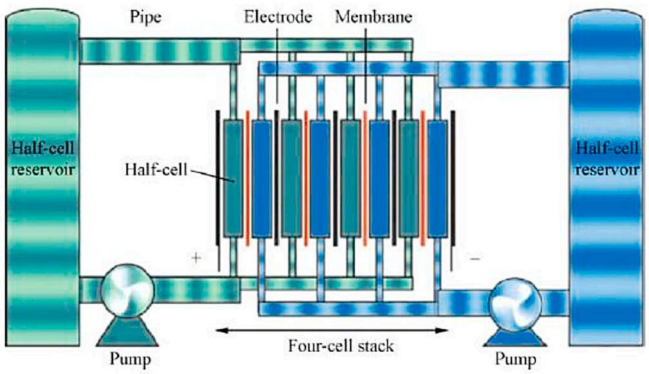


Fig. 21. Schematic diagram of flow battery [10].

Table 5
Comparison between parameters for different battery technologies.

Parameters	Lead-Acid battery	Li-Ion battery	Flow battery
Efficiency	75 %–80 %	80 %–86 %	60 %–70 %
Energy density	50 Wh/kg to 100 Wh/kg	200 Wh/kg to 350 Wh/kg	20 Wh/kg to 70 Wh/kg
Power density	10 W/kg to 500 W/kg	100 W/kg to 3500 W/kg	n. a
Life cycle	500 to 2000	1000 to 5000 cycles	>10000
Calendar life	5 years–15 years (depending on temperature and soc)	5 years–20 years (depending on temperature and soc	10 years–15 years
Depth of discharge	70 %	Up to 100 %	100 %
Self- discharge	0.1 % per day to 0.4 % per day	5 % per month	0.1–0.4 % per day
Power installation cost	150 €/kW to 200 €/kW	150 €/kW to 200 €/kW	1000 €/kW to 1500 €/kW
Energy installation cost	100 €/kWh to 250 €/kWh	300 €/kW to 800 €/kW	300 €/kW to 500 €/kW

thermochemical reactions [122].

2.4.1. Sensible heat storage systems (SHSS)

In SHSS, the heat is stored by increasing the medium temperature without transition its initial phase. The stored energy is proportional to material mass, the charging/discharging temperature change, and the specific heat capacity [17]. SHSS is the cheapest and simplest TESS. Materials used for this system can be divided into liquid and solid. Water

Table 6
Strength and weakness for electrochemical energy storage systems ECESS.

Storage type	strength	weakness	Use in RE systems
Lead-Acid battery	-Fast reaction speed -Low self-discharge rate -High cycle efficiency -Low capital cost	-Low energy density -Impact on the environment	Wind parks, PV
Li-Ion battery	-High energy density -Fast reaction speed -Low self-discharge rate -Long cycle life -High reliability	-Require working temperature -Need overcharge protection	Wind parks
NaS battery	-High energy density -Low self-discharge rate -Fast reaction speed -Nontoxic materials	-High internal resistance -Sodium corrosion -Additional system for high temperature heating	Wind parks
NiCd battery	-High energy density -Long cycle life -High reliability	-Environmental hazards -Affected by memory effect	Wind parks, PV
Flow battery	-Fast reaction speed	-Environmental issues -No large-scale application experience	Wind parks

is the most material used because of its low cost, availability, and high specific heat capacity [121]. Thermal oil and molten salt are utilized for high-temperature applications. Solid materials like: rocks, sands, gravel, wood, ceramics, and concrete [123] that are used for high-temperature applications although they have higher cost and lower energy density than liquid materials [121]. SHSS storage efficiency is (50%–90 %) [121].

2.4.2. Latent heat storage system (LHSS)

Thermal energy is stored in the form of latent heat when a substance undergoes a transitional phase and its state changes from one form to another. The most famous transition state is the change of the state of matter from a solid form to a liquid form [121]. Moreover, it can be changed from solid to liquid or liquid to gas and vice versa [4]. The used materials called phase change materials (PCM) [17]. Throughout the

Table 7
Challenges and limitations of batteries for different systems as ESS.

REF	Challenge	ESS Device	Isolated/ Grid connected	Limitation	Contribution
[91]	-Minimize cost	Battery	Grid connected	Power quality issue is unsatisfactory	Optimal allocating of the batteries in the distribution system with PV generation.
[92]	-Minimize cost	Lead acid battery	Grid connected	Power quality is not improved	Minimizing the total cost of the grid connected system. Optimal size, location of lead acid battery and optimal operation are studied.
[28]	-Minimize battery maintenance cost -Minimize losses	Battery	Grid connected	Optimal charge/ discharge of BESS is complicated	Optimal sizing a daily charge /discharge of BESS in LV distribution network with high PV penetration is studied.
[93]	-Minimize operational and investment cost	Li- io battery	Isolated	Trapping solver in local optima	Using a combination of self-adapted evolutionary strategy with Fischer–Burmeister algorithm to minimize the investment and operational cost for hybrid RE system.
[94]	-Minimize investment cost Minimize Energy error	Na–S battery	Isolated	Power quality is not improved	Using grey wolf optimization method for sizing electrical energy storage system in microgrids
[95]	-Minimize investment cost	Battery	Grid connected	Battery degradation is not considered	Optimization of BESS for different ownership structures in a peer-to-peer energy sharing community
[96]	-Sizing and allocation of battery banks -Optimal number and location of switching devices -Equipment cost	Battery	Grid connected	Power quality is not improved.	Using the Non-Dominated Sorting Genetic Algorithm II (NSGA-II) for optimal design for distributed networks using ES devices.
[97]	-Minimizing total cost	Battery	Grid connected	Lack of battery control algorithm	Preventing over and under voltage in radial LV distribution network.
[98]	-Maximize PV utilization -Minimize battery degradation	Battery	Grid connected	Complex computations	Using a combination of Model Predictive Control (MPC) strategy and Benders de-composition technique. Longer for planning distributed battery storage
[99]	-Minimize system cost	Battery	Isolated	Slow convergence	Using Cuckoo Search algorithm for optimal sizing of a remote hybrid renewable energy System. Comparing the results with GA and PSO.

material's phase change, the heat is stored or emanated, and the medium's temperature is constant. The material, during charging, absorbs heat and its temperature rises until its melting point [124]. At this point, the material absorbs heat to change its phase while its temperature stops rising. LHSS charging and discharging relies upon the utilized PCM melting and solidification [125]. PCM can be categorizes into organic and inorganic. Paraffin, fatty acid, esters, alcohols, glycols, and eutectics are deemed as organic PCM. Whilst salt hydrates, nitrate salts, carbonate salts, chlorine salts, sulfate salts, fluorine salts, hydroxides, metal, alloys, and salt eutectics are deemed as inorganic PCM [126]. LHSS has a storage efficiency of (75 %–90 %) and its capacity if 4 times larger than of a SHSS [127]. LHSS is more thermal behavior stable whilst charging and discharging processes than SHSS [128]. Nowadays, bio-based PCM is taking more interest as they are relied on renewable raw materials and they have lower flammability compared to paraffin [107]. LHSS research is mainly focused on the presenting new storage media and enhancing thermodynamic properties of the existing ones [129]. A new PCM is examined that it is fatty acid derivative of vegetable and animal oils [130].

2.4.3. Thermo chemical energy storage systems (TCESS)

In this type, the heat is not stored directly but utilizes a physico-chemical process [14]. The heat is consumed during charging process and released during discharging [12]. Absorption and adsorption of energy is an example of physicochemical process [126]. Fig. 26 represents the working principles of a TCESS. During charging, a thermo chemical material *C* absorbs energy and gets separated to 2 materials *A* and *B*. This reaction is called endothermic. While discharging, the stored heat is released as the materials *A* and *B* pose initial material *C* and this is called exothermic [6]. The materials *A* and *B* are stored in separated

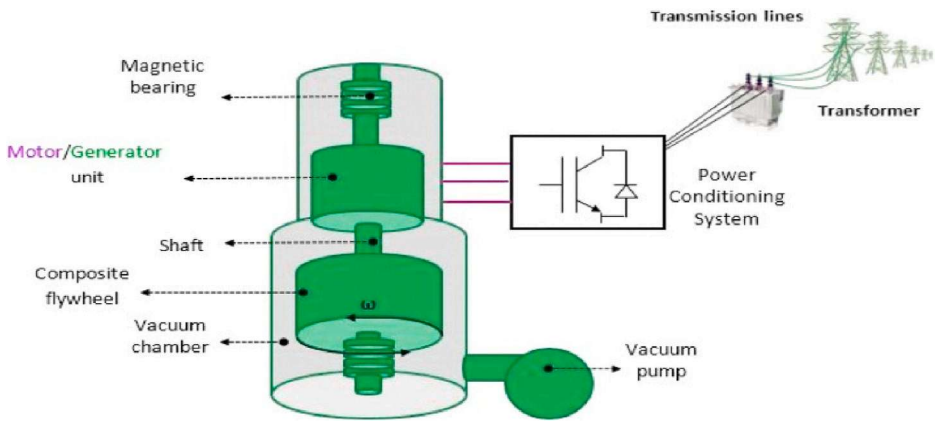


Fig. 22. Schematic diagram of flywheel energy storage system source [102].

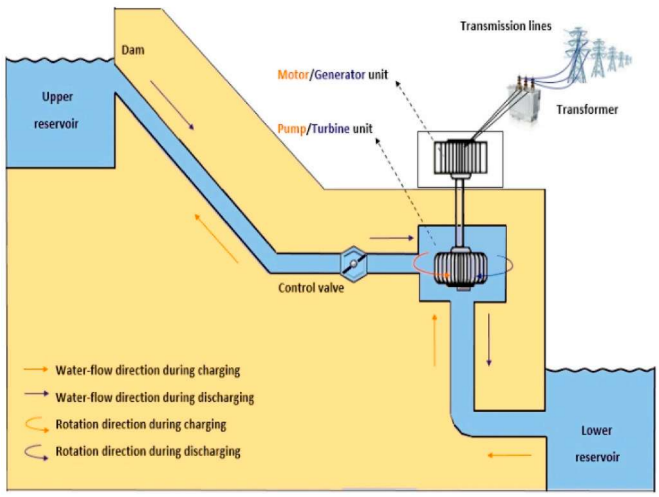


Fig. 23. Pumped hydro storage systems [12].

rooms, so, there is no self-discharging [9]. TCESS storage efficiency is (75%–99 %). TCESS has higher energy capacity than SHSS and LHSS and they are able to store energy for long periods with very low energy losses [126]. The strength and weakness of TESS and their use in RES systems are presented in Table 10. Also, some papers that concerns with several issues using TESS are tabulized in Table 11.

Table 11 presents challenges and limitations of TESS. All TESS can be used in different systems (grid connected or isolated systems) and it cab be integrated with other storage devices such as BESS. All types can improving the battery life cycle and reduce total system cost and CO_2 emission. LHSS can reduce energy loss.

2.5. Chemical energy storage systems (CESSs)

Chemical energy is put in storage in the chemical connections between atoms and molecules. This energy is released during chemical reactions and the old chemical bonds break and new ones are developed. And therefore the material's composition is changed [9]. Some CESS types are discussed below.

Table 8
Strength and weakness for mechanical energy storage systems.

	Strength	Weakness	Use in RE systems
Flywheel Energy Storage	-High energy density -Fast charging speed -Long lifetime -High cycle efficiency	-Low power density -High self-discharge -High cost -Heavy maintenance workload	Wind parks
Pumped hydro storage systems	-High capacity -Long lifetime -Low maintenance cost	-Large unit size -High capital cost -Terrain constrains -Centralized	Wind parks, hydro electrics
compressed air energy storage	-Long lifetime -Fast reaction speed -Environmentally friendly -High capacity -Low cost	-High requirements for geographical environment -Low round trip efficiency -Need underground cavities	Wind parks, hydro electrics

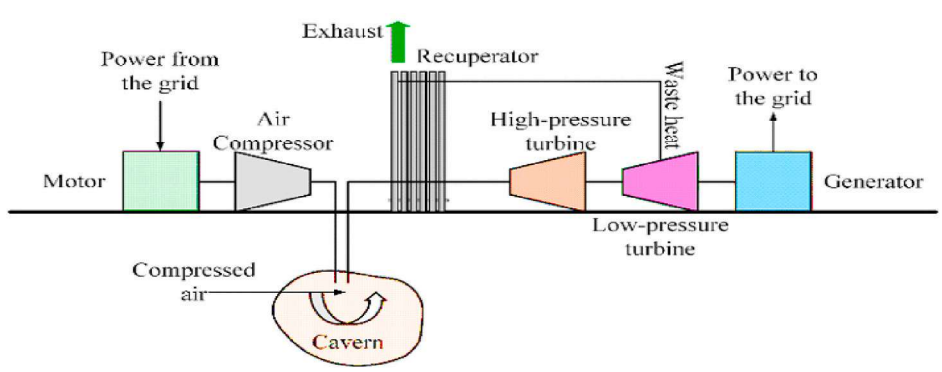


Fig. .24. Schematic diagram of (CAES) Plant [10].

Table 9
Challenges and limitations of MESS for different systems.

Ref	Challenge	ESS Device	Isolated/Grid connected	Limitation	Contribution
[109]	-Minimize cost Minimize losses	FES	Isolated	Power quality is not improved	Planning ESS with studying the effects of transmission losses and increased penetration of RE.
[110]	-Control DC link voltage Control FES speed	FES	Grid connected	PQ is unsatisfactory	Control of FES in case of Uncertainties using tube based MPC.
[111]	-Minimize cost Minimize losses	PHES	Grid connected	PQ is not improved	Using Multi-Objective Particle Swarm Optimization (MOPSO) to get the optimal size of standalone system and comparing the results of this method with GA, Simulated Annealing method (SA) and weighted sum approach (WSA).
[112]	Minimize cost	CAES	Isolated	Computational complexity	Using modified bacteria foraging algorithm to get the optimal configuration of HES based CAES and comparing the results with differential evolution.
[113]	Minimize the overall cost	CAES	Grid connected	Power quality is not improved	Using The Monte–Carlo simulation method to estimate the (electrical, thermal, gas load, wind turbine and electricity price) uncertainties. Considering P2G technology, along with the CAES system, reduce gas costs and the total operating cost of EHS and reduce the amount of electricity sold from the upstream network.
[114]	Control active power, reactive power, and SOC.	CAES	Grid connected	Cost is not considered	Implement a transient stability model of a system composed of two CAES. Studying the effects of cavern sizes on the system frequency
[115]	Minimize system cost	CAES	Isolated	Computational complexity	Using Monte Carlo simulation (MCS) to study the benefits of utilizing CAES for RES.
[116]	Control system voltage	PHES	Isolated	Cost is not considered	Generating a continuous power from PHES for a hybrid system consists of mixed-integer linear programming (MILP) for short term scheduling for WTHS
[117]	Minimize cost	PHES	Isolated	Computational complexity	
[118]	Smoothing Fluctuations of Photovoltaic Power	PHES	Grid connected	Cost is not considered	Using fuzzy CEEMDAN algorithm to calculate the target power combined system composed of cascade hydro stations, PV, and PHES.
[119]	-Minimize the integral of time multiplied absolute error (ITAE).	PHES BESS	Isolated	Degradation of BESS is not considered. Cost is not considered.	Using coyote-optimization algorithm (COA) to control MG system containing of wind, solar, biodiesel and a storage system composed of (mini-PHES and BESS) for getting a reliable system performance.
[120]	Cost reduction	PHES BESS	Isolated	Battery degradation is not considered	Using HOMER to perform comparative analysis for nine HRES.

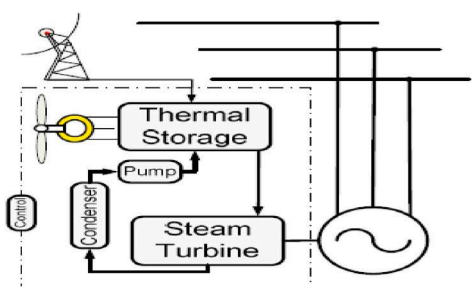


Fig. 25. TES simplified diagram [82].

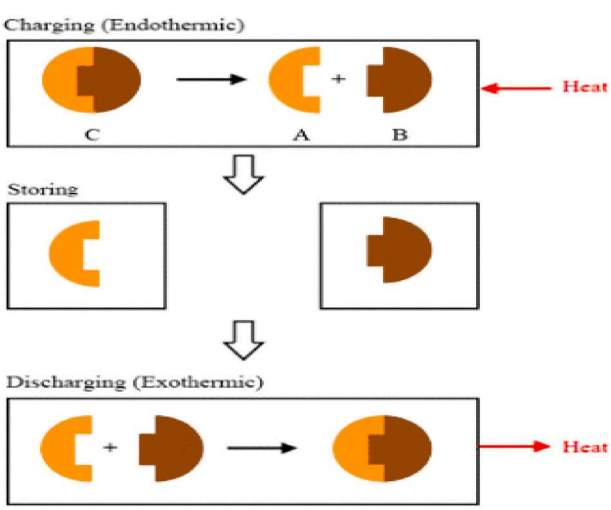


Fig. 26. Working principles of a TCESS [10].

Table 10
Strength – weakness of TESS and their use in RES systems [9].

TESS	strength	Weakness	Use in RES system
SHSS	-No toxic or expensive materials used -Many available materials -Low price	-Small energy density -High cycle efficiency -Energy density affected by the materials	Solar panels, geothermal
LHSS	-High energy density -Small range of temperature change	-Differentiation of PCM volume per cycle -High demand for PCMs	Solar panels, geothermal and PV
TCESS	-High efficiency -High energy density -Long term stable storage period -Low energy loss	-High manufacturing cost -Low efficiency -Poor heat transfer performance	No use

2.5.1. *Fuel cells FC*

Fuel cells receive an inflow of fuel from an external source and convert it into electrical output. This fuel can be (hydrogen, methanol, or hydrazine) or it can be obtained indirectly from converting (natural gas, ammonia, ethanol, or hydrocarbon gases) into a hydrogen. The anode is a hollow vessel lined with a layer of porous carbon on which hydrogen is pushed, and the cathode has the same composition as the anode and oxygen is pushed on it, where the porous carbon allows the contact of the anode and cathode with the electrolyte solution [68]. Hydrogen gas enters from the inlet in a very large amount and oxidation occurs at the barrier each atom loses an electron and turns into a positive ion. The electrolyte membrane allows the H^+ to flow from anode to cathode but does not permit the electrons flow electrons are released to the cathode using an external circuit where oxygen from air is supplied and reduction occurs. The unreacted oxygen is exited from the other side. The resulting water vapor is collected and condensed and used as drinking water in spacecraft [34]. The cell reactions are represented below in Fig. 27 [10].

Anode : $H_2 \Rightarrow 2H^+ + 2e^-$

Table 11
Challenges and limitations of TESS for different systems.

REF	Challenge	ESS Device	Isolated/ Grid connected	Limitation	contribution
[131]	Minimize energy loss.	LHSS	Isolated	Power quality is not considered.	Utilizing a cascaded latent thermal energy storage (CLTES) based on a control charging method to improve the charging and discharging thermal energy.
[132]	Improve the battery life cycle.	TESS with Li-ion battery	Isolated	Cost is not considered.	Introduced a HESS composed of TEES with Li-ion battery to solve the overheating problem and improve the battery life cycle.
[133]	Thermal management of li-ion bettery using Graphene -enhanced hybrid PCM	LHSS Li-ion battery	Isolated	Power quality is not considered	Using Graphene -enhanced hybrid PCM for solving the overheating problem for li-ion battery
[134]	Minimize total system cost	TESS	Isolated	Power quality is not considered.	Comparing operation strategies of two HTESS. The first one is composed of two tank TES and the other consists of packed bed TES
[135]	-Minimize CO_2 emission Minimize system cost	TESS	Isolated	Overall power quality is not improved	Using TES for increasing primary energy efficiency in industrial aspects and as a result minimizing the total cost.
[136]	-Finding optimal sizing Minimize levelized cost of energy.	TESS BESS	Isolated	Power quality is not improved	Using GA-PSO for finding the optimal sizing of a system composed of concentrated solar power, TES and battery.

$$\text{Cathode}: 2O_2 + 2H^+ + 2e^- \Rightarrow H_2O$$

$$\text{Overall}: H_2 + \frac{1}{2}O_2 \Rightarrow H_2O$$

FCs are categorized based on the used electrolyte. These are: alkaline FC, phosphoric acid FC, solid oxide FC, molten carbonate FC, proton exchange membrane FC (PEMFC), and direct methanol FC. Among all, alkaline FC has an efficiency of 60 % whereas the PEMFC delivers 58 % and molten carbonate gives 47 %. PEMFC is ideal for transport applications owing to its low operating temperature, quick start-up, and rapid load with low voltage and high current [137]. Most of the fuel cells currently in existence are in their early stages and are used in some limited applications such as aerospace and as a generation back-up in large scale grid [105].

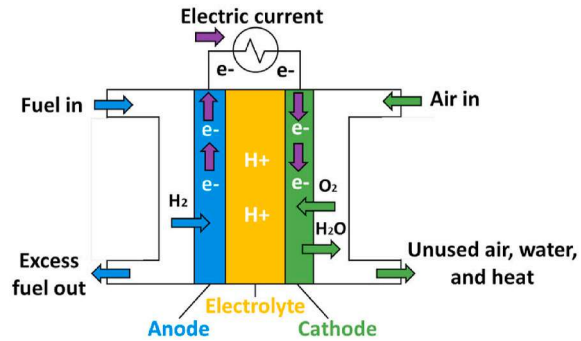


Fig. 27. The schematic diagram of the fuel cell [138].

2.5.2. Hydrogen storage

This technology is composed of an electrolyser to transform the electrical energy into hydrogen, a reservoir to store the produced hydrogen, and a conversion system like FC to convert the chemical energy to an electrical form. The produced hydrogen is stored, liquified or compressed. The chemical process of hydrogen production is shown in Fig. 28. The major merit of hydrogen is that there is no emission of harmful gases [1]. For renewable energy sources, the excess electricity is used for water electrolysis to split the water into its basic components (hydrogen and oxygen) then they are stored in tanks where hydrogen may be consumed in one of three ways [103]. Directly as a fuel: hydrogen can be transformed to electricity through a FC or combustion engine. As a feedstock: by chemical combination of hydrogen and carbon dioxide to produce synthetic natural gas ($2H_2 + CO_2 \Rightarrow CH_4 + O_2$) which can then be injected into natural gas pipelines. Blended with natural gas: hydrogen may be injected into some natural gas pipeline systems to supply infrastructures or end-use devices. Compared to the other energy storage technology, hydrogen technology cost is very low however, its efficiency is not very high So, it is suitable when the total amount of energy stored is more valuable than efficiency [139]. The different hydrogen storage mechanisms are as follows: liquid hydrogen storage, compressed and stored in a pressure tank, physical adsorption in carbon, complex compounds, and metal hydrides.A comparison of

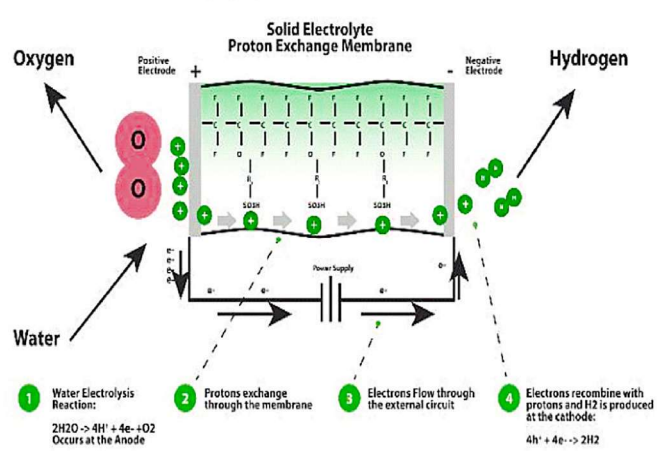


Fig. 28. Scheme of chemical process of hydrogen production [103].

hydrogen storage capacity is presented in Fig. 29 [1].

2.5.3. Ammonia storage

Ammonia can be easily stored in large quantities in liquid form, making it an ideal chemical store for renewable energy. The idea stems from the fact that there is excess energy during the night and can be used in the production of ammonia and then stored for use when needed. Storing hydrogen in large quantities is difficult and expensive, while ammonia is easier and cheaper to store and transport, and it can easily be cracked to provide hydrogen gas when needed and used in fuel cells [140].

2.5.4. Biofuels

Biofuels, are a eco-friendly, locally available, sustainable, and reliable fuel obtained from renewable sources [141]. Plants are a source of biofuels, as they work to trap sunlight in the form of chemical energy inside them through the process of photosynthesis, and this energy can be used to suitable forms and used for energy needs. Biofuels provide 3 % of the world's transportation fuel. Biofuels are in the form of liquid or gaseous fuels that are produced from biomass by chemical, thermal, or biological processes. Liquid fuels, like, ethanol, methanol, biodiesel, and gaseous fuels, like hydrogen and methane [141]. Liquid biofuels can be utilized in transportation, engines, or fuel cells to generate electricity. The USA, Brazil, Germany, Argentina, and China are the leading countries in the production of biofuels in the world, where they produced together 80.2 % of the world biofuel production in 2018 [96].

2.5.5. Aluminum energy storage

Aluminum is inexpensive and abundant, as it is the third most abundant element on earth. Excess electricity from renewable energy sources is used to produce the first aluminum using corundum. Solid aluminum can be stored and transported easily and used when needed without safety concerns. Upon discharge, the aluminum first oxidizes, producing hydrogen, heat, and aluminum oxide. These by-products can be used as sources of energy [142]. Several papers that concern with several issues using chemical energy storage systems are tabulized in Table 12.

Table 12 indicates It has been noticed challenges and limitations of CESS. It can be used in different systems (grid connected or isolated systems) and cab be integrated with other storage devices such as BESS. All types have the potential in minimizing cost, reducing CO_2 emission, increasing the battery life time, minimizing losses, improving system reliability.

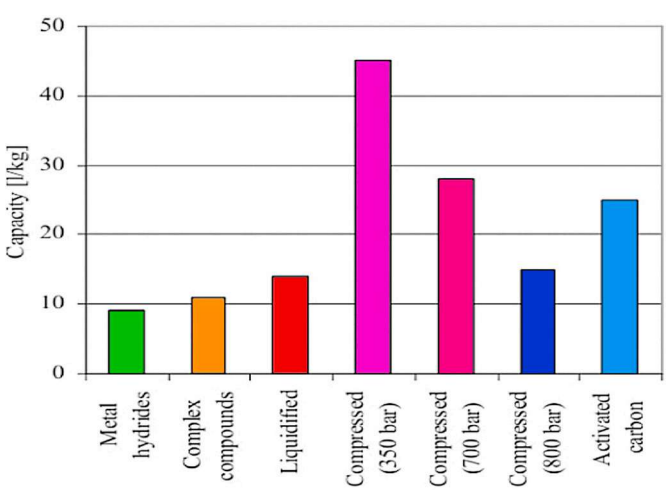


Fig. 29. Comparison of hydrogen storage capacity [1].

3. Hybrid energy storage system (HESS)

HESS is made by integrating more than one type of energy storage systems. It has a great importance, as renewable energy sources have intermittent characteristics in energy production and it is difficult for a single energy storage system to meet the energy requirements of a particular consumer [7]. ESSs can work in either of two modes: high-power mode and high-energy mode. High-power ESSs like (flywheel ES, SMES, SCES, BESS, etc.), respond fast (few seconds to a few minutes) and has high power density. They can used for voltage stabilization and improve the power system dynamic response. On the other hand, they have high self-discharge rate and high cost per unit capacity so, they are not appropriate for large capacity and long-term storage [150]. While high-energy ESSs such as (PHS, CAES, fuel cells, BESS, etc.) respond slowly, and they have high energy density so, they can used for long-term energy systems. Their demerits are that they have a short cycle life, cannot be charged and discharged rapidly, and are not suitable for real-time scenarios requiring dynamic compensation [151]. Both modes are used for a single HESS application. HESS may improved performances, enhanced efficiency, increased life expectancy, and lessened costs [152]. HESSs can be used in several applications, such as in hybrid electric vehicles, fuel-cell-powered electric vehicles, renewable energy supply systems utilizing battery/hydrogen combination, grid-tied HESS in local or provincial use, and large-scale wind and solar farms [151]. At present, HESS has come to be one of the hot investigated fields all over the world. Here are several typical HESS combinations.

3.1. Super capacitors and batteries

So many papers have been published for introducing using the combination of super capacitors and batteries for optimizing the performance of Electric Vehicle (EV). In Ref. [75] authors proposed a Muti Source Inverter for active control of energy storage systems in EV applications and a Space Vector Modulation technique and a deterministic State of Charge (SOC) controller are also introduced for control of the switching actions and the operation of the SC bank. The convenience of this configuration has checked out by MATLAB. The adaptation of the HESS containing SC and battery in the DC distribution network that can restrain DC voltage flicker and enhance the system stability, is presented in Ref. [153]. In Ref. [154], authors studied the use of bidirectional two-quadrant frontend dc–dc converter to control the energy flow between the Lithium-Ion battery bank and super capacitor (SC) bank. This model offers good dynamic performance and well-organized output voltage. Implementation of Fuzzy Logic control for EV using SC and Li-ion battery is presented in Ref. [79].

3.2. SMES and batteries

A study in Ref. [155] proposed the using of SMES and battery storage system to stabilize a photovoltaic based microgrid. A comparison, using MATLAB, between the system containing the SMES-battery and the system of battery only is carried out. The study proved that the SMES-battery is better in dealing with the microgrid transient faults and the it can reduce the fault current to avoid an unnecessary off-grid. In Ref. [66], the design of high temperature superconducting with the battery to form HESS is proposed. The paper showed that; this configuration can reduce the voltage fluctuation due to cloudy events and by using low resistance of high temperature superconducting cables, the voltage profile can be improved. Authors in Ref. [156] introduced the design and implementation of SMES-battery hybrid energy storage system in electric vehicle (EV). It used a novel nonlinear robust fractional-order control of SMES-battery to optimize the power demand. A case study is carried out to verify the effectiveness of this control strategy in improving the battery life cycle and compared with other control methods.

Table 12
Challenges and limitations of CESS for different systems.

REF	Challenge	ESS Device	Isolated/Grid connected	Limitation	contribution
[143]	-Minimize total life cycle cost Improve system reliability.	Hydrogen	Isolated	Power quality is not improved.	Optimal sizing of stand-alone system consists of PV, wind, and hydrogen storage.
[144]	Minimize life cycle cost	Hydrogen BESS	Isolated	Battery degradation is not considered.	Modelling and optimal design of HRES.The optimization results demonstrate that HRES with BESS offers more cost effective and reliable energy than HRES with hydrogen storage.
[145]	-Minimize total net present cost TNPC -Minimize loss of power supply probability (LPSP)	FC	Isolated		Multi-objective design of HESS composed of PV, FC and diesel generator to supply power for an off-grid community.
[146]	Improve system reliability -Minimize Loss of Power Supply Probability (LPSP), levelized Cost of Energy (LCOE) and Net Present Value (NPV). Minimize CO_2 emissions	FC BESS	Isolated	Computational complexity	Using multi objective PSO algorithm for optimal design of HRES.
[147]	Minimize Loss of Power Supply Probability (LPSP)	FC BESS	Isolated	Battery degradation is not considered	new real-time optimization algorithm based on Lyapunov optimization framework and novel queueing theory is proposed to optimal design the SMG with BSS.
[148]	Cost reduction Increase lifetime	FC BESS	Isolated	Power quality is not improved	experimental plat- form designed and constructed to test operation modes for hydrogen renewable power plants integrating HESS
[149]	Minimize net present value of the operation cost. Increase lifetime	Hydrogen BESS	Isolated	Power quality is not improved	Techno-economic optimization for HRES for off grid applications using Linear Programming.

3.3. Flywheel and batteries

In [157], authors provided a study of using a hybrid energy storage system combined of battery and flywheel to mitigate load fluctuations in electric ships. A typical prediction algorithm was developed for demonstrate the validation of this strategy. Authors in Ref. [158] proposed the installation of flywheel/battery HESS in a house on the island in Greece for supplying the house with loads and a financial accounts are made for analysis its economic feasibility. In Ref. [159], authors represented a residential Micro-Grid, consists of a photovoltaic plant integrated with a flywheel/battery HESS. A Matlab Simulink model (for AC and DC bus configurations) is developed. From the results, it is showed that the AC bus MG is the better in interfacing with the grid than the DC bus MG (peak current value is reduced by 58 % and transient time is 30 % shorter).

3.4. Compressed air and supercapacitor

In [160], aurhors introduced a HESS composed of CAES system and super capacitors SCs to improve the power quality of the power grid. A control strategy is developed for the system to track the 24 h power demand curve effectively. Authors in Ref. [161] proposed a CAES – SCs HESS to improve the voltage stability. Also, SCs can be used as a filter to smooth the power outputs.

3.5. Thermal energy storage and batteries

Authors in Ref. [132] introduced a HESS composed of thermal energy storage system TES with Li-ion battery to solve the overheating problem while using Li-ion battery only and improve the battery life cycle. In Ref. [133], authors examine HESS consists of TESS and batteries for heat handling battery management problem and reliability improvement the battery.

4. Challenges for integrating energy storage systems

Reliability and sustainability are the main aspects related to integrating ESSS to the modern power networks. However, this can be challenged. Hence, the next challenges should be considered for success integration of ESS [162].

4.1. Battery degradation

One of the main problems associated with batteries, is degradation problem. Owing to, rising in battery temperature because of the charging and discharging cycling and aging problem that affects the battery performance over the time. In Ref. [163], it is represented a control strategy to manage a BESS in a microgrid for enhancing the ESS life time based on battery SOC and maximum capacity. The overall BESS life span enhanced by 57 %.

4.2. Battery SOC effects on ESS

Energy storage systems' stability and performance are highly affected by the SOC. Some works have been studied these goals. A piecewise linear SOC controller has been created to stop BESS depletion before it reaches minimum levels for integrating SOC into low-inertia power systems' primary frequency control [164]. Furthermore, another research has looked into SOC balancing control in distributed battery systems. Researchers have used multi-agent consensus theory and dynamic event triggering coordination algorithms to efficiently accomplish SOC balance while consuming less communication [165]. Also, fractional-order modeling and Kalman filters improve estimation accuracy and dependability, demonstrating decreased errors compared to standard approaches under diverse working situations [166]. Accurate SOC estimation is also essential for supercapacitor functioning. All of these investigations indicate how SOC has a major impact on energy storage systems.

4.3. ESS sizing and allocation

The sizing and placement of energy storage systems (ESS) are critical factors in improving grid stability and power system performance. Numerous scholarly articles highlight the importance of the ideal ESS placement and sizing for various power grid applications, such as microgrids, distribution networks, generating, and transmission [167, 168]. Numerous crucial factors must be taken into account for Energy Storage System (ESS) sizing that is optimal. Market pricing, renewable imbalances, regulatory requirements, wind speed distribution, aggregate load, energy balance assessment, and the internal power production model are some of these factors [169]. An ideal ESS size that guarantees a steady supply of energy can be achieved by carefully taking into account all of these factors [170]. An ESS that is appropriately sized and

distributed can save costs, improve the use of renewable energy, and help with frequency management, all of which improve grid dependability and lower operating costs [171]. To address the difficulties in ESS planning, design, and implementation, sophisticated approaches, algorithms, and optimization techniques are being created, opening the door for more research and innovation in this area [172,173]. In distribution networks with high Distributed Generation (DG) penetration, the placement of energy storage systems (ESSs) is critical to addressing controlling voltage and system losses. Numerous approaches have been put out to optimize the placement and sizing of energy storage systems (ESSs) [174]. In order to identify the most efficient ESS size and location, these optimization procedures frequently use multi-objective functions that take into consideration PV panel power, self-consumption schemes, and the direction of demand growth. Distribution networks may experience better overall system efficiency, decreased losses, and improved voltage management by carefully choosing where to install energy-storage sensors using multi-objective optimization models and thorough sensitivity indices [175]. In order to facilitate power allocation to various storage technologies inside the hybrid energy storage system HESS, a basic optimization approach for choosing a low-pass filter's cut-off frequency has been proposed in Ref. [168]. The features of storage technologies are greatly impacted by the optimal cut-off frequencies that are determined by the optimization framework. This highlights the significance of precise power allocation for efficient grid support functions.

4.4. ESS financial feasibility

Understanding the technical sides of ESS technology and its application's economic viability is essential to assure the technology practicality. However, ESS's economic studies were quite restricted, where most of them, only the system capital cost was covered. For a comprehensive technoeconomic analysis, should include system capital investment, operational cost, maintenance cost, and degradation loss. Table 13 presents some of the research papers accomplished to overcome challenges for integrating energy storage systems.

It can be conclded from Table 13 that there are various solutions to overcome challenges facing integrating energy storage devices in isolated or grid connected systems. Utilization of HESS (SC + fuel cell, SMES + battery, battery + SC, etc) and applying optimization technique for optimal allcation or sizing of each device will lead to reducing cost, expanding ESS life time, improving efficiency and minimizing battery degradation.

5. Choosing principles for energy storage systems

There are many factors for selecting the suitable energy storage devices such as [34,182]:

- Capacity: The system energy stored is determined based on the capacity
- Power: How quickly the stored energy discharged and charged is determined based on the power.
- Efficiency: It expresses the amount of energy lost during the storage period and during the charging/discharging cycle, as it is the ratio between the energy provided to the consumer to the energy required for charging.
- Storage period: Denotes how long the energy is stored.
- Charge and discharge time: Expresses the time for charging and discharging.
- Lifetime: Denotes the time to use energy storage equipment.
- Cost: Depends on the storage equipment capital and operating costs and its life span.

Selection the superlative ESS for different applications is essential. In applications that require fast response such as frequency modulation, reactive power support, smooth transmission, and power quality improvement where millisecond response time is vital. FES, SMES, SC, and some batteries are highly recommended. Besides they have high efficiency and long lifetime. However, they have small energy ratio. ESS based on energy storage with hourly level response time is needed for energy time shift and capacity unit applications. PHES and CAES can be used for these applications [183]. Lead-acid batteries are used in many applications such as UPS, power quality and frequency regulation due to their cost, reliability, and ripening of technology. In fact, the Li-ion battery has high efficiency and a large energy ratio, but its cost is high, therefore its use in power applications is limited [184]. The CESS and ECESS typically have greater efficiency but shorter response time. Moreover, MESS and TESS have longer discharge time and response speed. On the other hand, for the lifetime specification, the longer life span time, the lower replacement costs [1]. Table 14 represents the general characteristics for some of the above discussed ESS to help the reader for choosing the appropriate ESS for its application [185]. presented some indicators to facilitate decision-making/design of various storage technologies include storage capacity, maximum charge/discharge power, depth of charge, durability, cost, maximum self-discharge rate and storage weight.

From Tables 14 and it is apparent that the SC and SMES are convenient for small scale energy storage application. Besides, CAES is appropriate for larger scale of energy storage applications than FES. The

Table 13
Solutions for energy storage systems challenges.

Ref	Challenge	ESS Device	Isolated/Grid connected	Limitation	Contribution
[176]	Minimize energy cost	Battery –SC	Grid connected		Design of the battery degradation process based on the characterization of semi-empirical aging modelling and performance. Modelling of the dynamic behavior of SCs.
[177]	Minimize system cost	Battery Hydrogen storage	Isolated	Battery degradation is not included.	Four different practical case studies, i.e., an off-grid rural village, telecom tower, stand-alone welding shop, and a backup for lift load system are selected to demonstrate the proposed sizing methodology.
[178]	High cost Battery degradation	Battery Hydrogen storage	Isolated	Allocation is not concerned	Using evolutionary algorithms and mixed integer linear programming for sizing a MG containing PV panels, a BSS and HSS.
[179]	-Reduce system cost, improve efficiency	SMES - lead-acidbattery	Grid connected	Battery aging is not considered	The performance of the proposed system is applied on a residential PV system in case of load leveling and system efficiency.
[180]	Minimize energy cost	Hydrogen fuel cell - SC	Isolated	Battery aging is not taken into account	The allocation of supercapacitor enables to mitigate the draw of high power consumption, to avoid all fast charge/discharge cycles and consequently to minimize the number of used batteries.
[181]	-Expand ESS lifetime Minimize energy cost	Li-ion Battery – SC	Isolated		The study considers the SOC of both battery and SC to ensure long lifetime.

Table 14
General technical specifications of energy storage techniques [1,10,186,187].

Energy storage system	Power Rating	Discharge	Energy density Wh/kg	Energy cost €/KWh	Lifetime Efficiency
PHSS	100–4000 MW	1 hr–24 h	0.5–1.5	50–150	70–85 %
FES	0.002–20 MW	msec to 40 Min	5–130	1000–3500	90–95 %
CAES	50–300 MW	1he- 24 h	30–60	10–120	70–80 %
Ni-CD	0.001–0.1 MW	0.0003–1 h	40–60	200–1000	60–91 %
Li-ion	0.001–0.1 MW	0.0167–1 h	75–250	200–1800	85–100 %
Nas	0.5–50 MW	0.0003–2 h	150–240	200–900	85–90 %
Hydrogen	0.001–50 MW	14 hr- 24 h	800–10000	1–15	20–50 %
Supercapacitor	0.01–1 MW	msec to minute	0.1–15	300–4000	90-95ˆ
SMES	10 kW-10MW	msec to seconds	0.5–5	700–7000	80–90 %

CAES and PHES are suitable for centered energy storage due to their high energy storage capacity. The battery and hydrogen energy storage systems are perfect for distributed energy storage. Presently batteries are the commonly used due to their scalability, versatility, cost-effectiveness, and their main role in EVs. But several research projects are under process for increasing the efficiency of hydrogen energy storage system for making hydrogen a dated future ESS.

6. Applications of energy storage systems

Energy storage is utilized for several applications like power peak shaving, renewable energy, improved building energy systems, and enhanced transportation. ESS can be classified based on its application [188].

6.1. General applications

There are many general applications for ESS such as solar water heating, solar air heating, solar cooking, solar greenhouses, space heating and cooling in buildings, off-peak electricity storage, and waste heat recovery [189]. Also, applications of FES are presented in Ref. [190], involve uses in a variety of industries and frequency regulation due to its advantages, including its high energy storage density, quick charging and discharging times, and extended service life.

6.2. Energy utilities

Energy storage posted at any of the five main subsystems in the electric power systems, i.e., generation, transmission, substations, distribution, and final consumers. Some of the applications of ESS include transmission system congestion decreasing, storing energy during off peaks for using during on peaks, voltage and frequency control, reparation for unpredictable emergencies like generation unit failure, and providing a real-time balance between generation and load [139]. Using ESSs in public utilities is a significant way to control the intermittent nature of RE sources like wind and solar power [191]. By reducing variations in the production of electricity, energy storage devices like batteries and SCs can offer a reliable and high-quality power source [192]. By facilitating improved demand management and adjusting for fluctuations in frequency and voltage on the grid, they also contribute to lower energy costs. Authors in Ref. [193] represented some of these applications such as increasing RE penetration, load leveling, frequency regulation, and offering operating reserve. In Ref. [194], authors discussed some of energy storage technologies used in grids and the requirements to decrease costs and enhance performance for these technologies to expand their market penetration. Some applications of ESS application are summerized in Table 15.

6.3. Renewable energy utilization

The greater the use of renewable energy sources, the greater the need of energy storage sources to store energy in off-peak times and use it at on-peak ones, in addition to the continuous intermittent in the renewable energy sources [7]. Authors in Ref. [197], recommended that ESS that are scalable, resilient, and minimal maintenance, such as, FES, SC, SMES and most batteries, may be appropriate for distributed renewable

Table 15
ESS applications [195,196].

ESS			Application requirements			PHS	CAES	BESS	FES	SC	SMES
Application			Power rating (MW)	Discharge durations (HRs)	Response time						
Electric supply		Supply system capacity	1–1000	4–6	Mins	✓	✓				
		Load leveling	10–1000	2–10	Mins	✓	✓	✓			
		Peak shaving									
Additional survices		Load following	10–1000	2–4	Mins	✓	✓	✓			
		Spin and non spin reserves									
		Fast response spinning reserve	10–1000	1–2	<30 Sec	✓	✓	✓			
		Voltage and frequency regulation	1–1000	15-30 Min	Immediate			✓	✓		✓
		Black start	100–1000	1–6	Secs	✓	✓	✓			
Renewables integration		Renewable back up	0.0001–400	2–4	Mins	*	*	*			
		RE grid integration (brief duration)	0.2–400	10-15 Sec	Secs -Mins		*	*	*	*	*
		Fluctuation decreasing									
Grid system	Transimission	Transimission congestion reassurance	0.25–400	2–6	Mins	*	*	*			
	Distribution	Reduce outage frequency UPS	0.002–10	4–10	Secs- Mins			*	*		
		Voltage support	10–100	>15 Min	<1/4 cycle	*		*	*	*	*
Customers	End user	Enhance power reliability	0.002–10	2-5 Min	<1/4 cycle			*	*	*	
		Enhance power quality	0.002–10	10-15 Sec	<1/4 cycle			*	*	*	*

energy. Technologies that combine a solar energy source with ES are reviewed in many papers [198,199]. [101,200] recommended that FES are favorable devices for combination with wind and PV systems unlike to BESS as they are fast response.

6.4. Buildings and communities

Energy storage is used to facilitate the integration of renewable energy in buildings and to provide a variable load for the consumer. TESS is a reasonably commonly used for buildings and communities to when connected with the heating and cooling systems. Wide research is represented on storage materials, latest developments, conditions and performance, and restrictions for buildings uses [201,202], and [203]. In Ref. [204], authors indicated that the use of FES in buildings with installed solar PV panels greatly lowers system costs. Zero Energy Buildings (ZEBs) has gained a lot of attention over the past decade. TESS is a appealing option for the ZEBs improvement by decreasing the energy utilization of the buildings, enhancing system efficiency, and lowering the peak load [123].

6.5. Transportation

There are many requests for ESS that used in EVs such as, high power density, fast discharge, specifically when accelerating, extreme efficiency, easy control and regenerative braking capacity [7]. The highly used primary ESS in EVs are batteries. On the other hand, SC has high power densities than battery. So, a combination between Battery and SC for EVs can improve the performance for EVs, aircraft, and ships [188]. FES has also been applied for extended time in transportation systems [101]. It can deal well with unpredictable power consumption as it has high power density and it can be used as the main source of energy for propulsion [200]. Various constrains occur when using Li-ion batteries for transportation. in Ref. [205], recommended some methods for enhancing Li-ion batteries for EVs such as the use of organic instead of inorganic ones.

6.6. Applications of hybrid energy storage systems

The ability of hybrid energy storage systems (HESS) to integrate multiple storage technologies and provide high-energy and high-power densities makes them useful in a variety of sectors [30]. When it comes to electric vehicles, HESS is essential because it supplies the power and energy density required for performance and acceleration, going beyond what can be achieved with one storage technology alone. Furthermore, by facilitating a more sustainable energy ecology, HESS plays a key role in improving the efficiency and stability of electrical grids with a high penetration of renewable energy sources [206]. Batteries-Supercapacitor HESS is being more widely used in domains such as microgrids, smart grids, energy systems, and renewable energy integration [207]. This is because of its effectiveness in efficiently controlling power and energy. Additionally, in order to meet decarbonization regulations and run on sustainable electrical energy, the marine industry is increasingly using Battery Energy Storage Systems (BESS) in hybrid propulsion vessels.

7. New trends in energy storage systems

There are many trends in ESS. Top topics of storage energy are electric vehicles, thermal energy storage, lithium sulfur batteries, methane production, hydrogen storage, geothermal heat pumps, lithium-ion batteries, microgrids and supercapacitors. Some of research directions of each topic and some published papers are also listed in Table 16. The energy storage technology is well covered in this review. The use of ESS is crucial for improving system stability, boosting penetration of renewable energy, and conserving energy. Electricity storage systems come in a variety of forms, such as mechanical, chemical, electrical, and electrochemical ones. In order to improve performance, increase life expectancy, and save costs, HESS is created by combining multiple ESS types. Different HESS combinations are available.

Table 16
New trends in energy storage systems.

Topic	Research directions	Some published papers
Electric Vehicles	Charging stations	[208,209]
	Vehicle to grid	[210,211]
	Vehicle routing	[212,213]
	Location problem	[214,215]
	Wireless chareging	[216,217]
	Plug-in hybrid vehicles	[218]
Thermal energy storage	Heat transfer enhancement	[219,220]
	Low-temperature thermal energy storage	[221–223]
	Phase Change Materials	[224,225]
	Melting process	[226,226,227]
	Latent Heat (horizontal LH, cascaded LH, and reverse LH)	[228–230]
Lithium Sulfur Batteries	High-performancelithium–sulfur batteries	[231–233]
	Accelerating electrochemical reactions	[234]
	Alleviating the self-discharge	[235]
	Solid-state lithium-sulfur batteries	[236,237]
Methane Production	C O_2 methanation	[238,239]
	Low-Temperature Methanation	[240,241]
Hydrogen Storage	Solid state hydrogen	[238,242,243]
	Liquid organic hydrogen	[244,245]
	Dehydrogenation	[246,247]
	Adding graphene on the hydrogen storage	[248–250]
Geothermal Heat Pumps	Modelling	[251]
	Performance Optimization	[252,253]
	Hybrid system based geothermal energy	[254–256]
Lithium-ion batteries	High performance of lithium-ion batteries	[257,258, 258–261]
Microgrids	MG integrating EV	[262]
	Management of ESS in MGs	[263]
	MG with hydrogen energy storage	[264]
	Frequency control of standalone MG	[265–267]
	Optimal scheduling of MGs based ESS	[268,269]
Supercapacitors	High-performance electrode material for SC	[270–272]

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Hybrid electric vehicles, fuel cell-powered electric vehicles, grid-tied HESS, large-scale wind and solar farms, and several other applications are just a few of the many uses for HESSs. This article discusses several challenges to integrating energy-storage systems, including battery deterioration, inefficient energy operation, ESS sizing and allocation, and financial feasibility. It is essential to choose the ESS that is most practical for each application. FES, SMES, SC, and certain batteries are strongly advised for applications requiring quick response, such as frequency modulation, reactive power support, seamless transmission, and power quality enhancement. On the other hand, hourly level response time applications like capacity unit and energy time shift can make use of PHES and CAES. Additionally, new developments in energy storage systems (ESS) such as geothermal heat pumps, microgrids, SCs, methane generation, thermal energy storage, lithium sulfur batteries, electric vehicles, and hydrogen storage are covered in this overview.Due to ESS's high prominence as a study area, there are numerous search directions listed for each topic.

8. Conclusion

The energy storage technology is well covered in this review. The use of ESS is crucial for improving system stability, boosting penetration of renewable energy, and conserving energy. Electricity storage systems come in a variety of forms, such as mechanical, chemical, electrical, and electrochemical ones. In order to improve performance, increase life expectancy, and save costs, HESS is created by combining multiple ESS types. Different HESS combinations are available.The energy storage technology is covered in this review. The use of ESS is crucial for improving system stability, boosting penetration of renewable energy, and conserving energy. Electricity storage systems (ESSs) come in a variety of forms, such as mechanical, chemical, electrical, and electrochemical ones. In order to improve performance, increase life expectancy, and save costs, HESS is created by combining multiple ESS types. Different HESS combinations are available.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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Energy Storage System Location Study
For: Puget Sound Energy

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Power Systems Consultants

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1. Introduction

Puget Sound Energy (PSE) engaged Power Systems Consultants (PSC) to perform a qualitative and quantitative analysis for siting a possible Energy Storage System (ESS) within the PSE electrical system. PSE filed a draft All-Source Request for Proposals (RFP) for peak capacity resources on May 4, 2020. Interconnection studies of an ESS onto a transmission system can result in the need for significant and costly network upgrades, depending upon interconnection location. This report serves as a starting point for proponents or bidders into the RFP as an aid to determine potential / lower risk locations (with respect to network upgrade costs) for interconnection of energy storage resources (and others) into PSE's transmission system.

The ESS is expected to perform in a manner consistent with the FERC defined Network Resource Interconnection Service. In general, this study is like a Feasibility Study in concept, but not necessarily in scope. Screening techniques examined the potential ESS capacity available at several Puget stations. Detailed analysis (like those completed for a Feasibility Study) was not performed.

The FERC definition of Network Resource Interconnection Service (below) can be used as a contextual guide in order to understand the purpose of this study.

Network Resource Interconnection Service shall mean an Interconnection Service that allows the Interconnection Customer to integrate its Large Generating Facility with the Transmission Provider's Transmission System (1) in a manner comparable to that in which the Transmission Provider integrates its generating facilities to serve native load customers; or (2) in an RTO or ISO with market based congestion management, in the same manner as Network Resources. Network Resource Interconnection Service in and of itself does not convey transmission service.

Transmission Provider must conduct the necessary studies and construct the Network Upgrades needed to integrate the Large Generating Facility (1) in a manner comparable to that in which Transmission Provider integrates its generating facilities to serve native load customers; or (2) in an ISO or RTO with market based congestion management, in the same manner as Network Resources. Network Resource Interconnection Service Allows Interconnection Customer's Large Generating Facility to be designated as a Network Resource, up to the Large Generating Facility's full output, on the same basis as existing Network Resources interconnected to Transmission Provider's Transmission System, and to be studied as a Network Resource on the assumption that such a designation will occur.

The Interconnection Study for Network Resource Interconnection Service shall assure that Interconnection Customer's Large Generating Facility meets the requirements for Network Resource Interconnection Service and as a general matter, that such Large Generating Facility's interconnection is also studied with Transmission Provider's Transmission System at peak load, under a variety of severely stressed conditions, to determine whether, with the Large Generating Facility at full output, the aggregate of generation in the local area can be delivered to the aggregate of load on Transmission Provider's Transmission System, consistent with Transmission Provider's reliability criteria and procedures. This approach assumes that some portion of existing Network Resources are displaced by the output of Interconnection Customer's Large Generating Facility. Network Resource Interconnection Service in and of itself does not convey any right to deliver electricity to any specific customer or Point of Delivery. The Transmission Provider may also study the Transmission System under non-peak load conditions. However, upon request by the Interconnection Customer, the Transmission Provider must explain in writing to the Interconnection Customer why the study of non-peak load conditions is required for reliability purposes.

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1.1. Disclaimer

Note that all the information used for the study is available to any member of the public either directly (i.e., geo-location from the Department of Homeland Security) or via non-disclosure agreements with the Western Electricity Coordinating Council (for WECC base cases).

Some information (one-lines and station configurations) used (as an analytical aid) is based on FERC Form 715 submissions that pre-date (circa October 2001) the CEII classification of FERC 715 data. Station configurations and interconnections were confirmed with recent imagery.

The best possible data and analytical technique was used for this study; however, no warranty is offered by Power Systems Consultants for fitness of use of any data associated with this report or the contents of the report itself. PSC did not perform a purposeful review of base cases, maps, or one-lines for accuracy.

This study was completed outside of the OATT and is intended to broadly inform interested readers. It does not replace any OATT driven processes or documentation, nor is it intended to do so. The results in this document do not indicate that available transmission exists or that a station is suitable for interconnection from an official FERC LGIA process viewpoint.

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1.2. Energy Storage System (ESS) Discussion and Example

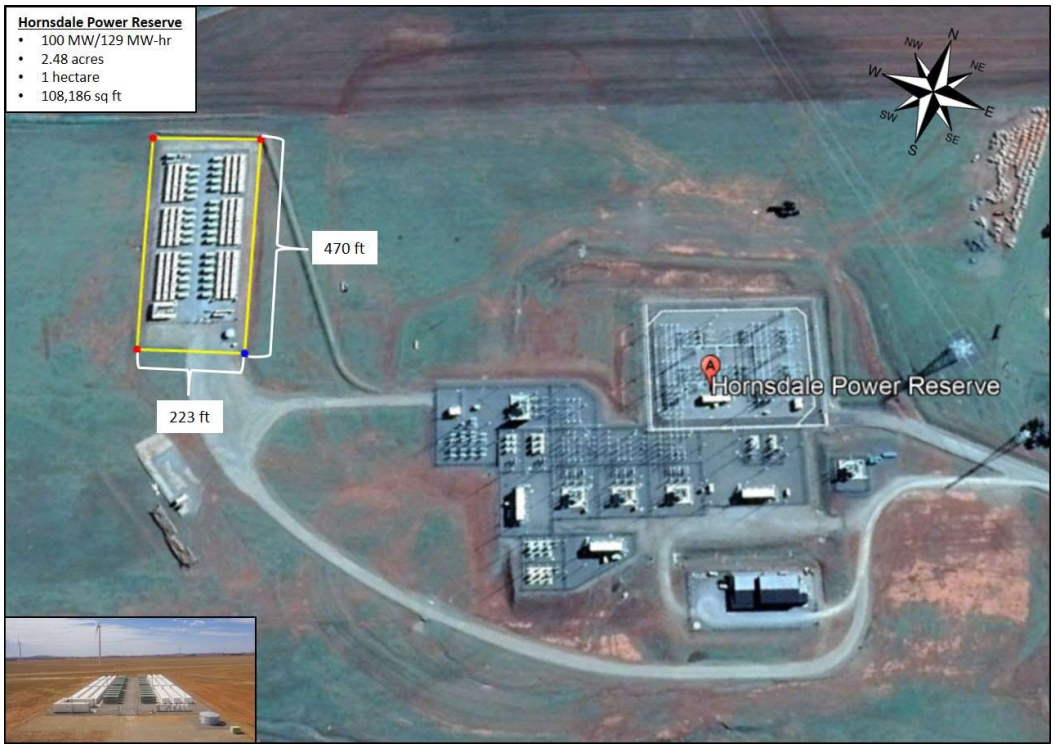
Modern utility scale ESS's store energy in the form of electro-chemical or mechanical energy, then convert that energy into electrical energy when appropriate, based on sophisticated control schemes.

Examples of electro-chemical storage include Lead Acid, Nickel-Cadmium, Lithium-Ion, and Molten Salt amongst others. Flow batteries are another type of electro-chemical battery, with Redox being an example. Mechanical energy storage examples include Flywheels, Pumped Hydro, and Compressed Air Energy Storage systems.

The study effort is agnostic to energy storage technology type and focuses primarily on the requirements of the ESS to interconnect on the PSE transmission system.

An example of a deployed Energy Storage System (located in South Australia) is shown in Figure 1.1. This is presently the world's largest ESS that uses Lithium-Ion batteries. The purpose of introducing this project is to give a sense of relative scale associated with a high energy capacity/high power ESS.

Figure 1.1 Hornsdale Power Reserve ESS



2. Methodology

Two methodologies were employed for this study. A qualitative and a quantitative method.

The qualitative method is a high-level review to determine potential for interconnection at the substation and to determine the potential to site an ESS in the area (PSE's property is not available for siting the ESS for this analysis). If a substation meets the evaluation metrics (detailed below) for the qualitative method, the locations will be further studied with the quantitative method.

The quantitative method is a high-level power flow analysis of the PSE transmission system, using official WECC databases to review the system performance with the addition of an ESS during charging and discharging conditions, for a multitude of system conditions and system contingencies.

These details of the qualitative and quantitative methods are discussed in the relevant section below.

2.1. Qualitative Method

Overhead imagery was utilized to determine the location of Puget's substations. This imagery was analysed in conjunction with WECC base cases and FERC 715 filings (pre-2001) that contain one-line drawings of the Puget system. We note that prior to October 2001 FERC 75 filings were available to the public. The stations were geo-located, mapped, locations were populated in the power flow-based cases, and then substations were created in the power flow base cases in order to support more detailed analysis using modelling and simulation tools.

2.1.1. Substation Interconnection Suitability

PSC examined the candidate substations to determine their suitability for expansion to accommodate interconnection of an ESS to the substation. This study assumes the ESS is sited off of PSE land in the area near the substation. Evaluation metrics are as below:

- Must interconnect to an existing Puget station
- Interconnects to PSE "native" network west of Cascades, no wheeling
- No radial or "return loop" transmission
- Above >100 kV point of interconnection (POI) per following details:
    - At least 4 lines for 115 kV candidate stations
    - Or non-radial 230 kV station
- Expansion space "in-the-gravel" in the station exists
- Development potential of existing station for interconnection is evident
    - Open space is desirable
    - Heavy residential presence is not desirable
    - Must pass the "Good Neighbor" test, which from an electric utility perspective has the following attributes:
        - Use of eminent domain proceedings is the absolute last resort with condemnation only used for those projects that are extremely mission critical and are supported politically.
        - The minimal number of landowners are impacted by a project and those landowners are justly compensated at prevailing rates.
        - Projects are developed with a focus on maximizing the use of existing "encumbered" properties.

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        - Land use should be reasonably consistent with its present use and the addition of electric utility infrastructure should be designed to be as unnoticeable as possible
        - Early involvement of the public in the development process is a must and the public should be encouraged to provide constructive input and alternative projects/locations
        - The public knows their neighbourhood best and can suggest minimum impact alternatives
        - Successful "Good Neighbor" projects leave the affected area better than it was before the project was executed.
- Identify substation configuration allows for additional breaker position
    - Ring bus, breaker and a half, double bus double breaker is preferred.
    - Main bus (with aux bus) has questionable reliability and could result in additional upgrades, up to rebuilding the substation to a different configuration.
    - Main bus (without aux bus) has poor reliability and is not suitable for interconnection of an ESS and would require substation upgrades, up to rebuilding the substation to a different configuration
        - An internal failure of a circuit breaker causes loss of entire station
- Identify existing unused breaker position (breaker not installed)
- Identify if the substation area allows for expansion
    - Examine available space inside substation fence
    - Examine available space outside substation fence
- If substation has 115 kV and 230 kV voltages, preference should be given to interconnect at the 115-kV side, unless interconnection at 230 kV results in substantial benefits.

2.1.2. ESS Siting Suitability

PSC examined how practical ESS siting near the substation is. This examination included:

- Land use and Zoning compatibility
    - Imagery analysis and general land usage was examined using tools such as Google Earth and Land Grid. These tools provide a means to develop a general qualitative sense of how favourable the location near a particular PSE station might be for an ESS project.
    - Highly residential areas, constraints for possible transmission rights-of-ways to the PSE station, schools, hospitals, and other notable land uses indicate that that specific PSE station was less desirable as a practical location to interconnect an ESS.
- Environmental Constraints
    - Overhead imagery analysis was performed in order to identify the possibility of complicated environmental constraints.
        - For example, the PSE Snoqualmie Falls station met the basic requirements of electrical connectivity but clearly it is not a desirable location for additional development. Thus, that station was not a candidate for further analysis.

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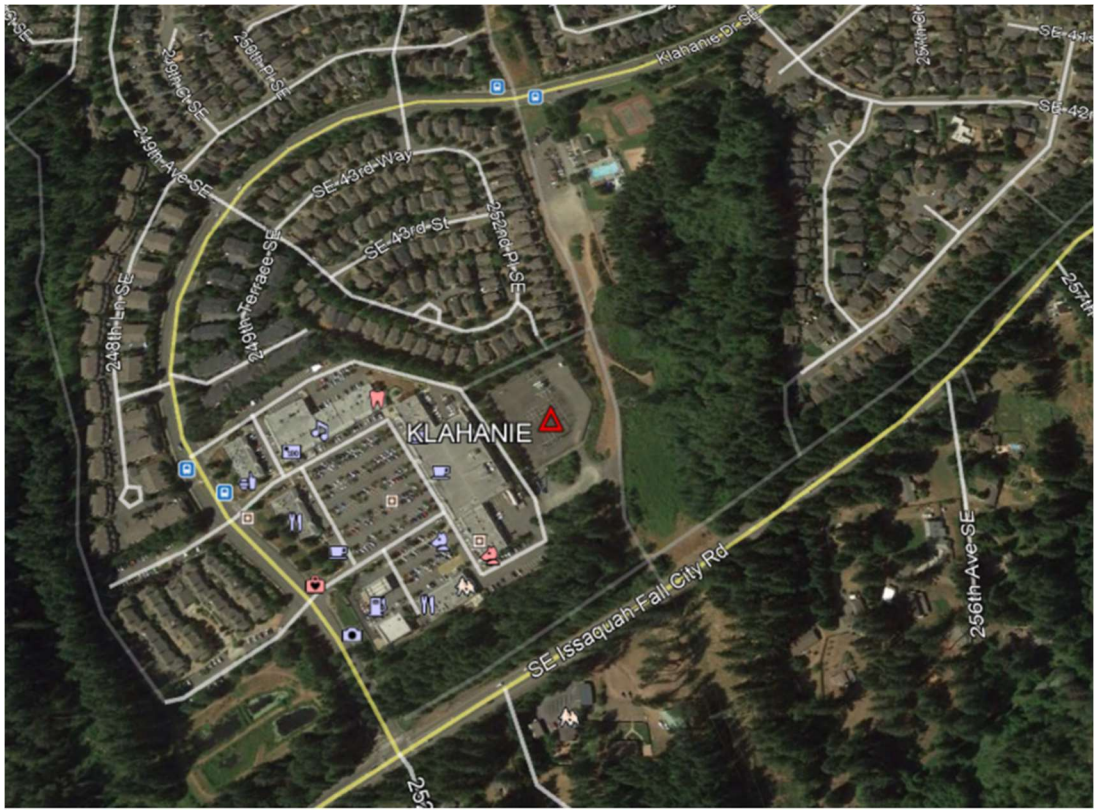
2.2. Qualitative Method - Example

Two examples of qualitative review (i.e., go or no-go) of candidate stations are briefly discussed as follows.

The Klahanie station (Figure 2.1) would be characterized as a high "risk" or red station. The Klahanie station is not desirable for an ESS interconnection due to its lack of space, residential encroachment, and general lack of development potential.

Figure 2.1 Undesirable Station: Klahanie



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The Alderton station (Figure 2.2) is an example of a low "risk" (i.e., green station) that has desirable attributes associated with the station such as:

- Space for development in the immediate area
- Space in the station for expansion
- Fairly rural area that might be more easily support new rights-of-way, station expansion, or ESs siting

Figure 2.2 Desirable Station: Alderton

2.3. Quantitative Method

PSC used WECC power flow base cases to examine the PSE transmission system for the list of substations feasible for ESS interconnection. PSC used the PowerWorld (version 21) power flow ATC tool to perform analysis that approximates a "light-weight" generation interconnection feasibility screening study. This study is not a feasibility study under the OATT, but rather an informational screening that could aid an RFP respondent in determining where to queue for a detailed LGIA interconnection request. These POI's were examined as charging (load) and discharging (generating) resources.

- Study Cases (WECC PowerWorld *.pwb power flow cases):
  - 2029-2030 Heavy Winter
    - Case used was 30HW1a1.pwb
  - 2030 Heavy Summer
    - Case used was 30HS1a.pwb
    - A 2029 HS case was originally used but then rejected due to an incomplete PSE transmission project that caused contingency performance issues (29HS1a1.pwb)
  - Off-peak load case (at consultants' discretion) which was the 2030 Light Spring case (30LSP1Sa.pwb)
- ESS studied as generation (discharging) and also as a load (charging)
  - ESS was studied one at a time
    - No groups or combinations of ESS's were studied
    - Only single ESS's were studied
- Only one interconnection per site location (either 115 kV or 230 kV, not both)
- Determine maximum ESS size at each location that results in acceptable system performance, for NERC TPL-001-4 PSE P0, P1 (N-1), and P6 (N-1-1) contingencies, while studying limited and sensitive neighbouring contingencies.

2.3.1. Quantitative Software Use and Approach

The results of the qualitative analysis and study were obtained using the "ATC" tool of PowerWorld Simulator. The details for implementing this in PowerWorld are briefly described as follows:

- Create an ALL WECC injection group of generators to dispatch against
  - The following metrics were used to select generators:
    - Pmax>10 MW
    - Pgen>10 MW
    - Pmin>0
  - ALL WECC injection group metrics (from 30HS case)
    - Number of generators is 2272
    - Total MW injection is ~191,294 MW
- Insert a single ESS (i.e. generator) and create an injection group for each station in Table 3.1
- Create an auto-inserted list of contingencies for Area 40
- Performed "Iterated Linear then Full Ctg" ATC analysis
  - Ignore elements with OTDFs < 3.0
  - Ignore elements with PTDFs<3.0
  - Report only:
    - 20 Transfer Limiters
    - 3 Limiters per ctg
    - 3 Limiters per element
- The results were manually inspected and those limiting elements and/or contingencies that were not relevant to the ESS were ignored for further analysis.
  - One may view this as machine aided learning to determine those contingencies and electrical system elements that are truly associated with electrical service to the ESS sites.
    - Many of these ignored elements/contingencies were 500 kV elements/contingencies with remedial action schemes or near their limits in the base case (for example various series capacitors associated with the California Oregon Intertie, etc).

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- The metrics associated with the quantitative analysis are noted below:
  - All elements with valid ratings were scanned for performance with the ATC tool for PO, P1, and P6 conditions of the NERC TPL-001-4 standard
    - Summer Emergency ratings were RATEA
    - Winter Emergency ratings were RATEC
    - Spring Emergency ratings were RATEG
  - P1 & P6 contingencies were those in the Northwest >100 kV
    - P1: 1135 out of 5081 contingencies were examined for detailed P1 performance
      - The smaller list of contingencies was selected using the Linear ATC tool which determined those contingencies sensitive to the PSE BESS sites.
    - P6: 1107 out of 144,453 contingencies were examined for detailed P6 performance
      - The smaller list was tested for performance using the Iterated Linear feature of the ATC tool. The larger amount was screened with the linear ATC tool.

3. Results

The results of the qualitative and quantitative analysis are listed below.

3.1. Qualitative Results

The results of the qualitative analysis and study were obtained in an iterative fashion. The list of candidate stations was then inspected both in PowerWorld Simulator and with overhead imagery to cull undesirable locations. The results follow:

- 382 total PSE initial stations (based on software results).
  - The 382-station count may not be a figure that exactly matches the number of stations that PSE has. This is due to the software requirement for a tapped line to be modeled with a bus, which might not be representative of an actual substation bus.
  - These 382 stations were geo-located.
- 36 PSE stations were kept for overhead imagery analysis based on the following:
  - Is 230 kV non-radial service.
  - Or is > 4 lines of 115 kV non-radial service.
  - And within PSE network
    - Determined from geo-location and bus ownership
  - Substation configuration metrics were not included in determining of the initial candidate stations.
- The 36 PSE stations were analysed and grouped by the following criteria for risk regarding ESS site location and interconnection:
  - Substation area analysis
  - Surrounding area analysis
  - Refined understanding of interconnection based on imagery analysis
- 12 stations (of the 36) were assigned “green”, for initial low risk ESS interconnection
- 8 stations (of the 36) were assigned “yellow”, for initial medium risk ESS interconnection
- 16 stations (of the 36) were assigned “red”, for high risk due to not meeting the initial qualitative screening metrics

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3.1.1. Candidate Stations

Table 3.1 lists the 20 PSE stations that were analyzed in detail. These stations were visually inspected with recent overhead imagery and are organized by color for low risk and medium risk substations. As previously stated, the substation configuration metrics were not used for the initial candidate stations and will be addressed later in the report. Substations that are of a main bus configuration are highlighted in red.

Table 3.1 Qualitative Results for Low Risk (Green) and Medium Risk (Yellow) Stations

Sub Name	Nominal kV Range	# of Lines	Bus Configuration (low & high voltage)	Zone
Alderton	115.0 (only)	7	Main & Aux	PIERCE
Berrydale	115.0 to 230.0	7	Main & Aux / Brk & half	S.KING
Christopher	115.0 (only)	6	Main Bus	S.KING
Frederickson	13.8 to 115.0	4	Main Bus	PIERCE
Fredonia	13.8 to 230.0 (115kV)	2	Main Bus	SKAGIT
Lake Tradition	115.0 (only)	8	Main Bus	N.KING
March Point	115.0 to 230.0	12	Main & Aux / Xfrm Term	SKAGIT
Midway	115.0 (only)	6	Main & Aux	S.KING
Saint Clair	115.0 to 230.0	7	Main & Aux / DB-DB	THURSTN
Sammamish	115.0 to 230.0	11	Main & Aux / Main & Aux	N.KING
Talbot Hill	115.0 to 230.0	14	Main & Aux / DB-DB	S.KING
Tono	115.0 (only)	4	Main & Aux	THURSTN
Bellingham	115.0 (only)	11	Brk & half	WHATCOM
Krain Corner	57.5 to 115	6	Main Bus	PIERCE
O'Brien	115.0 to 230.0	11	Main & Aux / Xfrm Term	S.KING
Portal Way	115.0 (only)	5	Main & Aux	WHATCOM
S. Bremerton	115.0 to 230.0	6	Main & Aux / Xfmr Term	KITSAP
Sedro Woolley	115.0 to 230.0	12	Main & Aux / Brk & half	SKAGIT
Starwood	115.0 (only)	4	Main Bus	S.KING
White River	115.0 to 230.0	12	Main & Aux / DB-DB	PIERCE

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Table 3.2 lists those stations that were deemed high risk and thus not selected for more detailed analysis.

Table 3.2 Qualitative Results for High Risk (Red) Stations

Sub Name	Nominal kV Range	# of Lines	Substation Type	Zone
ARCO C	115.0 (only)	4	Main Bus	WHATCOMI
BAKER SW	115.0 (only)	4	Main Bus	SKAGIT
BALDI	230.0 (only)	2	Tap	S.KING
CASCADE	34.5 to 230.0	3	Xfmr Term/Main Bus	KITTITAS
COTAGEBR	115.0 (only)	4	Main Bus	N.KING
ELECTHTS	57.5 to 115.0	5	Xfmr Term/Main Bus	PIERCE
HORSRNCH	230.0 (only)	3	Main Bus	N.KING
HRNCHTAP	230.0 (only)	2	Tap	N.KING
KLAHANIE	230.0 (only)	2	Tap	N.KING
LAKESIDE	115.0 (only)	7	Main Bus	N.KING
MINTFARM	13.8 to 230.0	1	Main (Gen Interconnection)	Portland Area
NOVELTYH	115.0 to 230.0	7	Main & Aux/Main Bus	N.KING
OLYMPA P	115.0 (only)	9	Main Bus	THURSTN
SHUFFLETON	115.0 (only)	4	Main & Aux	S.KING
SNOQ SW	2.0 to 115.0	5	Main Bus	N.KING
FREDONIA	13.8 to 115.0	4	Main Bus	SKAGIT

Note that there are two Fredonia stations, one serves a gas turbine power plant and the second serves local load. The “red” Fredonia station is the load serving station. Although these stations are “red” (or less desirable for ESS integration) they may be worthy of further review and analysis.

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3.2. Quantitative Results

3.2.1. Quantitative Results

Table 3.3, 3.4, and 3.5 lists the results from the quantitative analysis. The gen/load limit is equivalent to the discharge/charge limit for the ESS at the listed station for TPL-001-4 P0, P1, and P6 conditions (for the most limiting element). Units for the limits are MW. Note that we omit the negative sign for load since the sign is implicit in the definition of load.

Results shown in the tables indicate the ESS sizes for the different substations on an individual bases, meaning the potential size for a single ESS to be placed at any one of the locations listed. The results are not meant to indicate that the ESS sizes listed can be installed for all locations simultaneously.

BPA 500 kV contingencies (such as the Raver-Paul 500 kV line loss) were noted, but not considered as limiting contingencies since it is known that these contingencies have remedial action schemes associated with them. BPA has historically planned its system for P1 outages and has not necessarily planned (and built) its system to perform for P6 outages (without operator action).

A 2030 Light Spring case was examined to test performance under P0, P1, and P6 conditions to determine if there was any notable sensitivity to light spring conditions (in addition to the Heavy Summer and Heavy Winter cases).

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Table 3.3 P0 Quantitative Results

Quantitative Results - P0 Results in MW (Green shaded stations are low risk; yellow shaded stations are medium risk)								
Substation	**2030 Heavy Summer**		**2030 Heavy Winter**		**2030 Light Spring**		**Maximum ESS Size**	
	Generating	**Charging**	**Generating**	**Charging**	**Generating**	**Charging**	**Generating**	**Charging**
Alderton	725	(790)	872	(823)	886	(998)	725	(790)
Berrydale	982	(248)	1077	(273)	1031	(569)	982	(248)
Christopher	751	(419)	1031	(648)	842	(622)	751	(419)
Frederickson	432	(316)	485	(440)	404	(466)	404	(316)
Fredonia	510	(803)	679	(873)	538	(878)	510	(803)
Lake Tradition	725	(534)	993	(701)	888	(837)	725	(534)
March Point	664	(367)	834	(367)	701	(412)	664	(367)
Midway	550	(263)	711	(333)	558	(368)	550	(263)
Saint Clair	520	(546)	756	(732)	810	(854)	520	(546)
Sammamish	409	(677)	517	(818)	546	(702)	409	(677)
Talbot Hill	754	(768)	935	(916)	834	(896)	754	(768)
Tono	755	(445)	567	(524)	548	(699)	548	(445)
Bellingham	695	(578)	1028	(894)	809	(1072)	695	(578)
Krain Corner	250	(222)	480	(351)	377	(308)	250	(222)
O'Brien	681	(554)	807	(694)	672	(627)	672	(554)
Portal Way	443	(565)	441	(772)	337	(740)	337	(565)
S. Bremerton	426	(328)	471	(341)	457	(420)	426	(328)
Sedro Woolley	779	(950)	935	(1134)	867	(995)	779	(950)
Starwood	573	(335)	693	(341)	637	(578)	573	(335)
White River	872	(802)	1029	(945)	955	(887)	872	(802)

Charging limits have a parenthetical ( ) used in order to clearly indicate that the number is a charging (i.e. load) value. The maximum ESS sized is determined by the maximum size that the ESS can operate for all cases. Therefore, the minimum value between the three seasonal cases determines the maximum ESS size for performance under P0 conditions.

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Table 3.4 P1 Quantitative Results

Quantitative Results – P1 Results in MW (Green shaded stations are low risk; yellow shaded stations are medium risk)								
Substation	**2030 Heavy Summer**		**2030 Heavy Winter**		**2030 Light Spring**		**Maximum ESS Size**	
	Generating	**Charging**	**Generating**	**Charging**	**Generating**	**Charging**	**Generating**	**Charging**
Alderton	96	(366)	510	(581)	529	(655)	96	(366)
Berrydale	756	(167)	848	(181)	702	(437)	702	(167)
Christopher	552	(217)	758	(362)	613	(386)	552	(217)
Frederickson	135	(96)	308	(314)	266	(388)	135	(96)
Fredonia	110	(532)	161	(619)	124	(585)	110	(532)
Lake Tradition	518	(136)	811	(425)	664	(545)	518	(136)
March Point	272	(214)	555	(189)	485	(271)	272	(189)
Midway	432	(164)	530	(207)	446	(262)	432	(164)
Saint Clair	45	(254)	239	(423)	311	(685)	45	(254)
Sammamish	323	(99)	411	(370)	495	(425)	323	(99)
Talbot Hill	552	(242)	741	(459)	688	(590)	552	(242)
Tono	437	(85)	275	(374)	282	(543)	275	(85)
Bellingham	322	(109)	545	(452)	384	(656)	322	(109)
Krain Corner	136	(34)	250	(88)	188	(112)	136	(34)
O'Brien	535	(258)	634	(276)	559	(401)	535	(258)
Portal Way	105	(446)	392	(628)	284	(614)	105	(446)
S. Bremerton	313	(89)	301	(27)	375	(185)	301	(27)
Sedro Woolley	287	(589)	577	(715)	450	(700)	287	(589)
Starwood	373	(181)	545	(250)	459	(299)	373	(181)
White River	583	(379)	838	(434)	715	(592)	583	(379)

Charging limits have a parenthetical ( ) used in order to clearly indicate that the number is a charging (i.e. load) value. The maximum ESS sized is determined by the maximum size that the ESS can operate for all cases. Therefore, the minimum value between the three seasonal cases determines the maximum ESS size for performance under P1 conditions.

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Table 3.5 P6 Quantitative Results

Quantitative Results – P6 Results in MW (Green shaded stations are low risk; yellow shaded stations are medium risk)								
Substation	**2030 Heavy Summer**		**2030 Heavy Winter**		**2030 Light Spring**		**Maximum ESS Size**	
	Generating	**Charging**	**Generating**	**Charging**	**Generating**	**Charging**	**Generating**	**Charging**
Alderton	134*	(76*)	448	(205)	324	(290)	134*	(76*)
Berrydale	515*	(52*)	847	(90)	707	(336)	515*	(52*)
Christopher	484*	(57*)	756	(337)	610	(386)	484*	(57*)
Frederickson	99*	(86*)	275	(284)	222	(389)	99*	(86*)
Fredonia	9*	(378)	101	(421)	69	(479)	9*	(378)
Lake Tradition	521*	(44*)	805	(387)	664	(545)	521*	(44*)
March Point	9*	(54)	201	(62)	172	(78)	9*	(54)
Midway	428*	(56*)	512	(121)	444	(218)	428*	(56*)
Saint Clair	39*	(412)	147	(528)	159	(633)	39*	(412)
Sammamish	323	(46*)	411	(370)	495	(445)	323	(46*)
Talbot Hill	450*	(48*)	622	(359)	833	(896)	450*	(48*)
Tono	592	(122*)	267	(339)	548	(698)	267	(122*)
Bellingham	10*	(108)	418	(67)	382	(657)	10*	(67)
Krain Corner	136*	(34*)	178	(4*)	188	(112)	136*	(4*)
O'Brien	520*	(54*)	225	(176*)	560	(521)	225	(54)
Portal Way	11*	(446)	185	(362)	298	(614)	11*	(362)
S. Bremerton	314	(89*)	79	(23*)	375	(185)	79	(23*)
Sedro Woolley	48*	(590)	519	(622)	447	(755)	48*	(590)
Starwood	370*	(13*)	240	(107*)	460	(311)	240	(13*)
White River	365*	(13*)	382	(121*)	714	(750)	365*	(13*)

Charging limits have a parenthetical ( ) used in order to clearly indicate that the number is a charging (i.e. load) value. The maximum ESS sized is determined by the maximum size that the ESS can operate for all cases. Therefore, the minimum value between the three seasonal cases determines the maximum ESS size for performance under P6 conditions. Those limits with an asterisk (*) indicate that a pre-existing limit was ignored, and the first non-zero ATC transfer limit was recorded for the ESS charging and discharging contingency-based limit.

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4. Analysis

A review of Table 3.2, Table 3.3, and Table 3.4, indicate to the user the following:

- A single ESS performs for both discharging (generator) and charging (load) depending upon the substation location
  - Between 248 MW – 802 MW under P0 conditions
  - Between 45 MW – 434 MW for P1 conditions
  - Between 9 MW – 122 MW for P6 conditions
- Summer ratings can be most limiting and generally (but not always) summer may be the defining season for limiting an ESS.
  - This is due to limits being thermally based and higher summer temperatures causing de-rating of thermally limited equipment.
- Pre-existing conditions exist that should be examined in greater detail if any of these ESS locations are considered for interconnection.
- Limitations exist for P6 summer operations
  - Note that for ESS limits indicated with an asterisk (*) in the tables indicate there pre-existing P6 issues may exist.
- Some P6 contingencies may, surprisingly, perform better than P1 contingencies
  - The reasons for this are complex but, in many cases, the P1 limiting element is removed from service by the P6 contingency and thus a higher limiting element is relevant.

Table 4.1 shows the results for each substation on a contingency category bases, and also shows the maximum size for the ESS when generating or charging. Similarly, to before, the maximum size is the minimum value across the three contingency categories (i.e. P0, P1, and P6).

Further, the table shows the Total Maximum size of the ESS. The Total Maximum size is the minimum value (absolute) between the generating and charging values and represents the maximum size of the ESS that allows for unconstrained use during varying seasonal load conditions, varying operating conditions, and varying contingencies. The Total Maximum size is the value used to show the potential ESS size that might be achieved for NRIS while limiting the risk of additional costly network upgrades (transmission line rebuilds / reconductoring, etc.) outside of those required for interconnection to the substation.

The Operational Agreements determined with the developer could increase the Total Maximum size beyond the P6 charging limitations of the ESS listed in the table below.

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Table 4.1 Combined Quantitative Results

Substation	Substation Type	P0 Results		P1 Results		P6 Results		Maximum ESS		Total Maximum
		Generating	Charging	Generating	Charging	Generating	Charging	Generating	Charging	
Alderton	Main & Aux	725	(790)	96	(366)	134*	(76*)	96	(76*)	76*
Berrydale	Main & Aux	982	(248)	702	(167)	515*	(52*)	515*	(52*)	52*
Christopher	Main Bus	751	(419)	552	(217)	484*	(57*)	484*	(57*)	57*
Frederickson	Main Bus	404	(316)	135	(96)	99*	(86*)	99*	(86*)	86*
Fredonia	Main Bus	510	(803)	110	(532)	9*	(378)	9*	(378)	9*
Lake Tradition	Main Bus	725	(534)	518	(136)	521*	(44*)	518	(44*)	44*
March Point	Main & Aux	664	(367)	272	(189)	9*	(54)	9*	(54)	9*
Midway	Main & Aux	550	(263)	432	(164)	428*	(56*)	428*	(56*)	56*
Saint Clair	Main & Aux	520	(546)	45	(254)	39*	(412)	39*	(254)	39*
Sammamish	Main & Aux	409	(677)	323	(99)	323	(46*)	323	(46*)	46*
Talbot Hill	Main & Aux	754	(768)	552	(242)	450*	(48*)	450*	(48*)	48*
Tono	Main & Aux	548	(445)	275	(85)	267	(122*)	267	(85)	85
Bellingham	Brk & half	695	(578)	322	(109)	10*	(67)	10*	(67)	10*
Krain Corner	Main Bus	250	(222)	136	(34)	136*	(4*)	136*	(4*)	4*
O'Brien	Main & Aux	672	(554)	535	(258)	225	(54*)	225	(54*)	54*
Portal Way	Main & Aux	337	(565)	105	(446)	11*	(362)	11*	(362)	11*
S. Bremerton	Main & Aux	426	(328)	301	(27)	79	(23*)	79	(23*)	23*
Sedro Woolley	Main & Aux	779	(950)	287	(589)	48*	(590)	48*	(589)	48*
Starwood	Main Bus	573	(335)	373	(181)	240	(13*)	240	(13*)	13*
White River	Main & Aux	872	(802)	583	(379)	365*	(13*)	365*	(13)	13*

Those limits with an asterisk (*) indicate that a pre-existing limit was ignored, and the first non-zero ATC transfer limit was recorded for the ESS charging and discharging contingency-based limit. As stated above, the Operational Agreements determined with the developer could increase the Total Maximum size beyond the P6 charging limitations of the ESS.

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Table 4.2 shows a summary of the results for this effort. The table provides the reader with a convenient listing of the Total Maximum ESS output and the location of the electrical point of interconnection studied, as well as substation type, and operating voltage.

Table 4.2 Location Summary with Maximum ESS Results

Substation	Substation Type	Voltage (kV)	Location		Total Maximum ESS (MW)
			Latitude	Longitude	
Alderton	Main & Aux	115	47.15344	-122.2365	76
Berrydale	Main & Aux	115	47.37803	-122.1311	52
Christopher	Main Bus	115	47.33708	-122.2393	57
Frederickson	Main Bus	115	47.08061	-122.3647	86
Fredonia	Main Bus	115	48.45461	-122.4371	9
Lake Tradition	Main Bus	115	47.53069	-122.0117	44
March Point	Main & Aux	115	48.45714	-122.5625	9
Midway	Main & Aux	115	47.40239	-122.2944	56
Saint Clair	Main & Aux	115	47.03511	-122.7356	39
Sammamish	Main & Aux	115	47.68558	-122.1499	46
Talbot Hill	Main & Aux	115	47.46864	-122.191	48
Tono	Main & Aux	115	46.75539	-122.8775	85
Bellingham	Brk & half	115	48.75939	-122.4604	10
Krain Corner	Main Bus	115	47.23511	-121.9855	4
O'Brien	Main & Aux	115	47.40317	-122.2432	54
Portal Way	Main & Aux	115	48.90361	-122.63	11
S. Bremerton	Main & Aux	115	47.53764	-122.6914	23
Sedro Woolley	Main & Aux	115	48.50458	-122.204	48
Starwood	Main Bus	115	47.29039	-122.3623	13
White River	Main & Aux	115	47.239	-122.2096	13

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As discussed previously, the main bus substation configuration (without an aux bus) has questionable reliability and interconnecting at a main bus substation has the potential to result in the need for high network costs to rebuild the substation. The substations that are configured with just a main bus (with no aux bus) were removed from the results to create the final results table as shown in Table 4.3. The table provides the reader with a convenient listing of the Maximum ESS output and the location of the electrical point of interconnection studied, as well as substation type, and operating voltage.

Table 4.3 Final Results Table

Substation	Substation Type	Voltage (kV)	Location		Total Maximum ESS (MW)
			Latitude	Longitude	
Alderton	Main & Aux	115	47.15344	-122.2365	76
Berrydale	Main & Aux	115	47.37803	-122.1311	52
March Point	Main & Aux	115	48.45714	-122.5625	9
Midway	Main & Aux	115	47.40239	-122.2944	56
Saint Clair	Main & Aux	115	47.03511	-122.7356	39
Sammamish	Main & Aux	115	47.68558	-122.1499	46
Talbot Hill	Main & Aux	115	47.46864	-122.191	48
Tono	Main & Aux	115	46.75539	-122.8775	85
Bellingham	Brk & half	115	48.75939	-122.4604	10
O'Brien	Main & Aux	115	47.40317	-122.2432	54
Portal Way	Main & Aux	115	48.90361	-122.63	11
S. Bremerton	Main & Aux	115	47.53764	-122.6914	23
Sedro Woolley	Main & Aux	115	48.50458	-122.204	48
White River	Main & Aux	115	47.239	-122.2096	13

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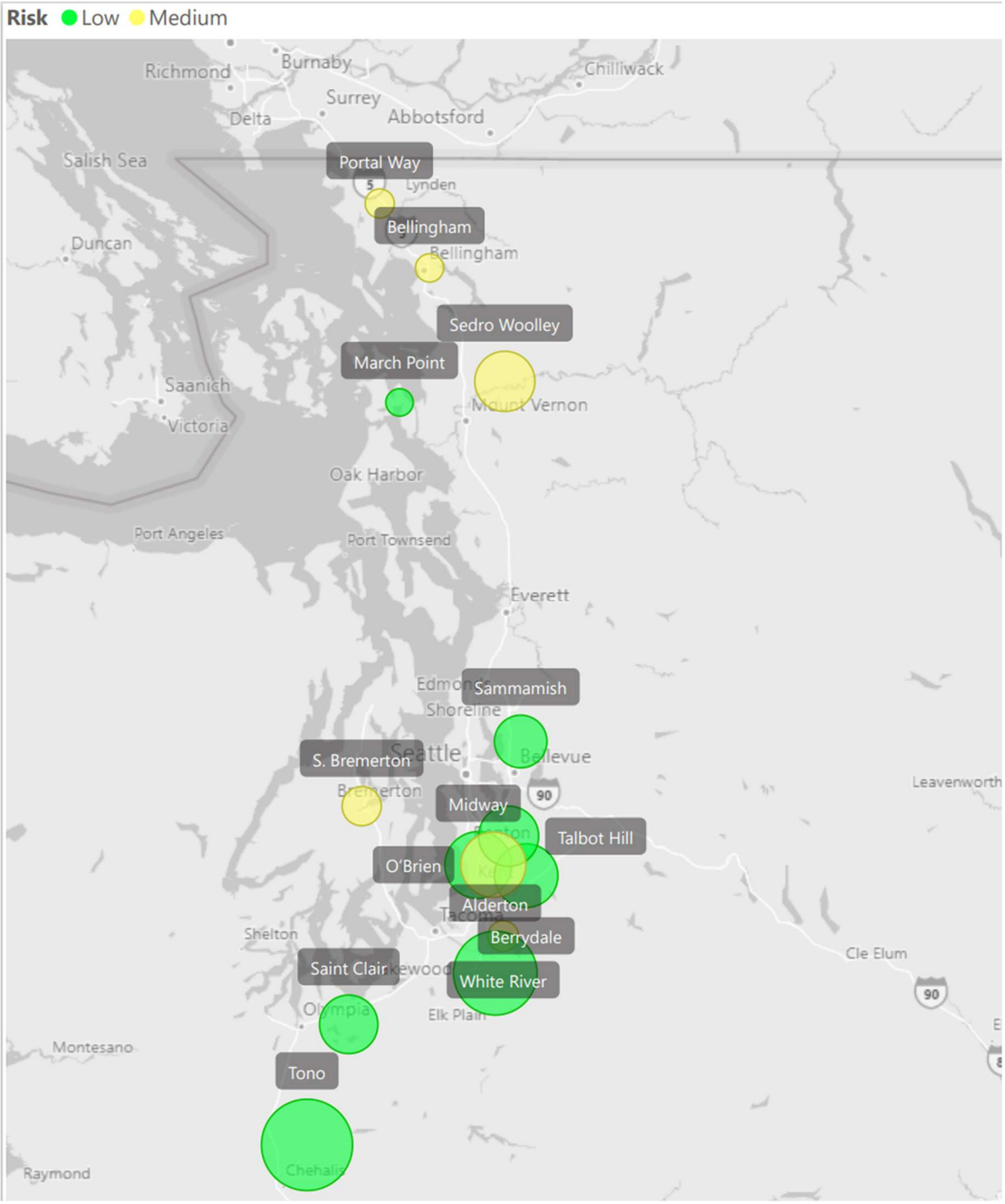
Figure 4.1 gives an approximate location of the substations with low and medium risk for interconnection. The figure shows that there are many opportunities throughout the native PSE system for interconnecting an ESS.

Figure 4.1 Location of Selected Stations



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5. Conclusions and Recommendations

PSC believes that opportunities exist for Puget Sound Energy to install Energy Storage Systems in several stations without undue impact (or required network upgrades) to the surrounding electrical transmission system. We base this conclusion of performance under P6 outages during heavy summer and winter peak load conditions, as required for Network Resource Interconnection Service for use as a capacity resource on PSE's transmission system.

As previously stated, the results of this effort are to be used to help guide proponents to locations (with approximate capacities) that might offer success for interconnection of an ESS for NRIS with limited network upgrades. The formal LGIA process, as detailed under the Puget Sound Energy FERC Open Access Transmission Tariff (OATT), will define required system interconnection upgrades and any potential network upgrades as a result of the more detailed studies (power flow and transient), impacts of projects already in the interconnection que, affected neighbouring transmission providers, and short circuit analysis.

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PUGET SOUND ENERGY

Puget Sound Energy service area

PSE: Washington's oldest local energy utility

Electric service:

All of Kitsap, Skagit, Thurston, and Whatcom counties; parts of Island, King (not Seattle), Kittitas, and Pierce (not Tacoma) counties.

Natural gas service:

Parts of King (not Enumclaw), Kittitas (not Ellensburg), Lewis, Pierce, Snohomish, and Thurston counties.

Washington state's oldest local energy company, Puget Sound Energy serves approximately 1.1 million electric customers and nearly 840,000 natural gas customers in 10 counties. A subsidiary of Puget Energy, PSE meets the energy needs of its customers, in part, through incremental, cost-effective energy efficiency, procurement of sustainable energy resources, and far-sighted investment in the energy-delivery infrastructure. PSE employees are dedicated to providing great customer service and delivering energy that is safe, dependable and efficient.

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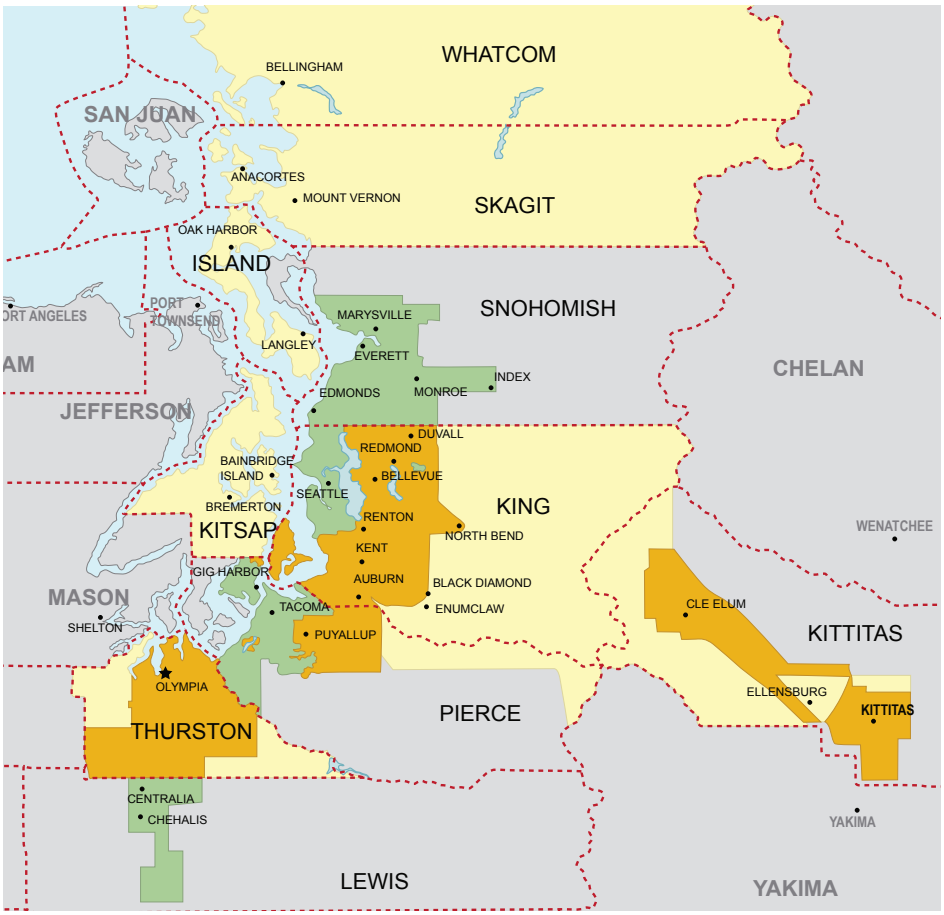

Combined electric and natural gas service

Electric service

Natural gas service

AGENDA BILL APPROVAL FORM

Agenda Subject:
Resolution No. 5825 (Hay)
A Resolution adopting the 2025-2029 Consolidated Plan and the 2025 Annual Action Plan

Meeting Date:
May 5, 2025

(RECOMMENDED ACTION: Move to adopt Resolution No. 5825.)

Department:
Human Services

Attachments:
Resolution No. 5825

Budget Impact:

Administrative Recommendation:
City Council to adopt Resolution No. 5825.

Background for Motion:
The City of Auburn receives a Federal Entitlement Grant through the Department of Housing and Urban Development. As a condition of the entitlement, every five years, the City is required to submit an updated Consolidated Plan and an Annual Action Plan to guide the investment of Community Development Block (CDBG) funds. Auburn is part of the larger King County Consortium. Therefore, Auburn's Consolidated Plan is part of the larger regional plan and expired on December 31, 2024. Resolution No. 5825, if adopted by City Council, adopts the 2025-2029 Consolidated Plan and the 2025 Annual Action Plan, and authorizes the Mayor to implement such administrative procedures as may be necessary to carry out direction of the legislation.

Background Summary:
Every five years, the City of Auburn is required to submit an updated Consolidated Plan to the Department of Housing and Urban Development to guide the investment of Community Development Block Grant (CDBG) Funds. Auburn’s current Consolidated Plan ended in December 2024.

Councilmember: Yolanda Trout-Manuel **Staff:** Kent Hay

RESOLUTION NO. 5825

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF AUBURN, WASHINGTON, ADOPTING THE 2025-2029 CONSOLIDATED PLAN AND THE 2025 ANNUAL ACTION PLAN

WHEREAS, the U.S. Department of Housing and Urban Development (HUD) designated the City of Auburn as an entitlement community for its Community Development Block Grant (CDBG) Program;

WHEREAS, the primary objective of the Consolidated Plan and CDBG Program is the development of viable urban communities by providing decent housing, a suitable living environment, and expanding economic opportunities, principally for persons of low and moderate income;

WHEREAS, to be eligible for funding, the City of Auburn must submit a Consolidated Plan to serve as a federally required planning document to guide the City of Auburn's human service and community development efforts;

WHEREAS, the planning process to develop the Consolidated Plan involved public participation and guidance from non-profit and governmental agencies serving low income residents in the community;

WHEREAS, the City Council of the City of Auburn heard and considered public comment about the proposed 2025-2029 Consolidated Plan and 2025 Action Plan;

NOW, THEREFORE, THE CITY COUNCIL OF THE CITY OF AUBURN, WASHINGTON, RESOLVES as follows:

Section 1. Pursuant to Chapter 24 of the Code of Federal Regulations Part 91, the City adopts the 2025-2029 Consolidated Plan and the 2025 Annual Action Plan.

Section 2. The Mayor is authorized to implement such administrative procedures as may be necessary to carry out directions of the legislation.

Section 3. This Resolution shall be in full force and effect on passage and signatures.

Dated and Signed: _____

CITY OF AUBURN

_____
NANCY BACKUS, MAYOR

ATTEST:

_____
Shawn Campbell, MMC, City Clerk

APPROVED AS TO FORM:

_____
Jason Whalen, City Attorney

AGENDA BILL APPROVAL FORM

Agenda Subject:
Resolution No. 5826 (Whalen)
A Resolution declaring certain Real Property as surplus and authorizing its disposal

Meeting Date:
May 5, 2025

(RECOMMENDED ACTION: Move to adopt Resolution No. 5826.)

Department:
Legal

Attachments:
Resolution No. 5826, Resolution No. 5826 Exhibit A

Budget Impact:

Administrative Recommendation:
City Council to adopt Resolution No. 5826.

Background for Motion:
Surplusing property that is no longer needed by the City is an important part of being good stewards of public resources. This process allows the City to divest its interest in the properties, eliminate ownership costs, reduce risk exposure, and eventually return the property to the tax rolls.

Background Summary:
The City owns two vacant land parcels, King County parcel numbers 0521059038 (“9038”) and 0521059152 (“9152”). Both parcels, 9038 in 1983 and 9152 in 1996, were acquired for future right of way and utility corridor purposes, though neither parcel was ever utilized by the City for those, or any other purposes. Public Works further verified that no municipal utilities exist within either parcel, and Public Works does not have any future need for either.

Parcels 9038 and 9152, are hereafter collectively referred to as the City Parcels.

Surplusing the City Parcels will allow the City to divest its interest in these properties, thereby reducing liability and ownership costs, and return the properties back to the tax rolls generating new tax revenue.

Councilmember: Kate Baldwin

Staff: Jason Whalen

RESOLUTION NO. 5826

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF AUBURN, WASHINGTON, DECLARING CERTAIN REAL PROPERTY AS SURPLUS AND AUTHORIZING ITS DISPOSAL

WHEREAS, the City of Auburn acquired adjoining real property parcels for future right of way and utility corridor purposes; and

WHEREAS, the properties were never utilized by the City; and

WHEREAS, through an internal review process, the City has determined that the properties are no longer needed for municipal purposes; and

WHEREAS, in light of this determination, it would be appropriate to surplus and authorize the disposal of the properties; and

NOW, THEREFORE, THE CITY COUNCIL OF THE CITY OF AUBURN, WASHINGTON, HEREBY RESOLVES as follows:

Section 1. Real Properties, parcels 0521059152 and 0521059038 which are legally described in **Exhibit A**, being generally located north of SE 304th Street, off of 112th Avenue SE, is hereby declared as surplus.

Section 2. The Mayor is authorized to dispose of the properties and to implement such administrative procedures as may be necessary to carry out the directives of this legislation.

Section 3. This Resolution will take effect and be in full force on passage and signatures.

Dated and Signed: _____

CITY OF AUBURN

_____
NANCY BACKUS, MAYOR

ATTEST:

_____
Shawn Campbell, MMC, City Clerk

APPROVED AS TO FORM:

_____
Jason Whalen, City Attorney

EXHIBIT A
Legal Description of Surplused Properties

Parcel 0521059152 legal description:

THAT PORTION OF THE SOUTH 30 FEET OF THE SOUTHEAST QUARTER OF THE NORTHEAST QUARTER OF THE SOUTHWEST QUARTER OF THE SOUTHEAST QUARTER OF SECTION 5, TOWNSHIP 21 NORTH, RANGE 5 EAST, W.M., IN KING COUNTY, WASHINGTON;

TOGETHER WITH THAT PORTION OF TRACT C, HAZEL HEIGHTS, ACCORDING TO THE PLAT THEREOF, RECORDED IN VOLUME 270 OF PLATS, PAGES 93 THROUGH 95, IN KING COUNTY, WASHINGTON;

LYING EAST OF THE FOLLOWING DESCRIBED LINE:

BEGINNING AT THE SOUTHWEST CORNER OF LOT 1, KING COUNTY SHORT PLAT 07617 RECORDED UNDER RECORDING NUMBER 9409200228 AND AS DEPICTED AND DESCRIBED ON RECORD OF SURVEY RECORDED UNDER RECORDING NUMBER 9702219001, RECORDS OF KING COUNTY, WASHINGTON;

THENCE SOUTH 04° 18' 21" EAST A DISTANCE OF 21.92 FEET;

THENCE SOUTH 09° 11' 32" WEST A DISTANCE OF 9.01 FEET TO THE SOUTH LINE OF SAID TRACT C AND THE TERMINUS OF THIS DESCRIBED LINE;

EXCEPT COUNTY ROAD

(ALSO KNOWN AS PARCEL Y, CITY OF AUBURN BOUNDARY LINE ADJUSTMENT NUMBER BLA25-0002 RECORDED UNDER KING COUNTY RECORDING NUMBER 20250428900002.)

Parcel 0521059038 legal description:

THAT PORTION OF THE SOUTH 30 FEET OF THE SOUTHEAST QUARTER OF THE NORTHEAST QUARTER OF THE SOUTHWEST QUARTER OF THE SOUTHEAST QUARTER OF SECTION 5, TOWNSHIP 21 NORTH, RANGE 5 EAST, W.M., IN KING COUNTY, WASHINGTON;

TOGETHER WITH THAT PORTION OF TRACT C, HAZEL HEIGHTS, ACCORDING TO THE PLAT THEREOF, RECORDED IN VOLUME 270 OF PLATS, PAGES 93 THROUGH 95, IN KING COUNTY, WASHINGTON;

LYING WEST OF THE FOLLOWING DESCRIBED LINE:

BEGINNING AT THE SOUTHWEST CORNER OF LOT 1, KING COUNTY SHORT PLAT 07617 RECORDED UNDER RECORDING NUMBER 9409200228 AND AS DEPICTED AND DESCRIBED ON RECORD OF SURVEY RECORDED UNDER RECORDING NUMBER 9702219001, RECORDS OF KING COUNTY, WASHINGTON;

THENCE SOUTH 04° 18' 21" EAST A DISTANCE OF 21.92 FEET;

THENCE SOUTH 09° 11' 32" WEST A DISTANCE OF 9.01 FEET TO THE SOUTH LINE OF SAID TRACT C AND THE TERMINUS OF THIS DESCRIBED LINE.

(ALSO KNOWN AS PARCEL Z, CITY OF AUBURN BOUNDARY LINE ADJUSTMENT NUMBER BLA25-0002 RECORDED UNDER KING COUNTY RECORDING NUMBER 20250428900002.)

AGENDA BILL APPROVAL FORM

Agenda Subject:
Resolution No. 5827 (Martinson)
A Resolution authorizing the Mayor to terminate the Interlocal Agreement between the City of Auburn and King County to stand up the City of Auburn Municipal Court

Meeting Date:
May 5, 2025

(RECOMMENDED ACTION: Move to adopt Resolution No. 5827.)

Department:
Human Resources and Risk Management

Attachments:
Resolution No. 5827

Budget Impact:

Administrative Recommendation:
City Council to adopt Resolution No. 5827.

Background for Motion:
Resolution No. 5827 would allow the Mayor to issue written notice of termination of the Interlocal Agreement for District Court Services to King County.

Background Summary:
The City of Auburn has been party to an Interlocal Agreement (ILA) with King County for District Court Services since 2012. Recently, King County provided notice that it would be charging cities for District Court Services on a full-cost recovery model. As a result, Auburn will be required to pay approximately $500,000.00 more, on an annual basis, for probation services previously included within the scope of the ILA. After review, study, and consideration of the services and costs to the City under the existing ILA, staff recommends that the City terminate that ILA, effective December 31, 2026, and that the City begin the process of standing up its own Municipal Court. In order to timely terminate the ILA, the City Council must authorize the Mayor to issue a written notice of termination of the ILA on or before May 12, 2025. This will terminate the ILA for District Court services effective December 31, 2026.

Councilmember: Cheryl Rakes

Staff: Candis Martinson

RESOLUTION NO. 5827

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF AUBURN, WASHINGTON, AUTHORIZING THE MAYOR TO TERMINATE THE INTERLOCAL AGREEMENT BETWEEN THE CITY OF AUBURN AND KING COUNTY TO STAND UP THE CITY OF AUBURN MUNICIPAL COURT

WHEREAS, in 2012, the City of Auburn entered into an Interlocal Agreement with King County for district court services ("ILA"); and

WHEREAS, the ILA provides for periodic review by all parties through the District Court Management Review Committee ("DCMRC"). At the DCMRC meeting on March 6, 2025, King County informed the City partners of their intent to move forward with a full cost recovery model for district court services, which will require the City of Auburn to incur additional costs for probation services totaling over five hundred thousand dollars annually; and

WHEREAS, in connection with the ongoing and changing judicial responsibilities with which the City is involved, the City Council has explored alternative approaches to address municipal court cost structures and efficiencies through phased court study presentations from the National Center for State Courts; and

WHEREAS, after a thorough review of the alternatives and options available to the City, it is advantageous for the City to establish their own municipal court;

WHEREAS, the current ILA term extends through December 31, 2026 and is terminable by the participating city by providing written notice to the County by May 12, 2025, for termination effective December 31, 2026.

NOW, THEREFORE, THE CITY COUNCIL OF THE CITY OF AUBURN, WASHINGTON, RESOLVES as follows:

Section 1. The Mayor is authorized to terminate the ILA between the City of Auburn and King County for district court services, no later than May 12, 2025, for a termination date effective December 31, 2026.

Section 2. The Mayor is authorized to enter into additional agreements and to implement those administrative procedures necessary to carry out the directives of this Resolution.

Section 3. This Resolution will take effect and be in full force on passage and signatures.

Dated and Signed: _____

CITY OF AUBURN

_____
NANCY BACKUS, MAYOR

ATTEST:

_____
Shawn Campbell, MMC, City Clerk

APPROVED AS TO FORM:

_____
Jason Whalen, City Attorney

AGENDA BILL APPROVAL FORM

Agenda Subject:
Resolution No. 5830 (Gaub)
A Resolution authorizing the Mayor to execute and administer agreements between the City of Auburn and the Washington State Department of Commerce relating to Project No. CP2141, Downtown Auburn Theater

Meeting Date:
May 5, 2025

(RECOMMENDED ACTION: Move to adopt Resolution No. 5830.)

Department:
Public Works

Attachments:
Resolution No. 5830

Budget Impact:

Administrative Recommendation:
City Council adopt Resolution No. 5830.

Background for Motion:
This Resolution authorizes the Mayor to enter into an agreement with the Washington State Department of Commerce for grant funds in the amount of $1,498,650.00 for the reconstruction of the Auburn Avenue Theater and was included in the budget for this project.

Background Summary:
Resolution No. 5830 authorizes the Mayor to enter into an agreement with the Washington State Department of Commerce to accept and utilize Washington State grant funds for the Auburn Avenue Theater Rebuild Project.

This grant, in the amount of $1,498,650.00, was included in the City's 2024 adopted Budget and is part of the overall funding package for the construction of this project. The project will reconstruct the Auburn Avenue Theater, which was demolished in October of 2024. It is anticipated that construction for the new Performing Arts Theater will begin in early 2026 with an estimated construction timeframe of 12 to 18 months.

Councilmember: Tracy Taylor

Staff: Ingrid Gaub

RESOLUTION NO. 5830

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF AUBURN, WASHINGTON, AUTHORIZING THE MAYOR TO EXECUTE AND ADMINISTER AGREEMENTS BETWEEN THE CITY OF AUBURN (THE CITY) AND THE WASHINGTON STATE DEPARTMENT OF COMMERCE RELATING TO PROJECT NO. CP2414, DOWNTOWN AUBURN THEATER

WHEREAS, the City applied for, and has been awarded, grant funding for the Auburn Downtown Theater project (Project) that will design and construct a new performing arts theater; and

WHEREAS, the Project is included in the City's 2024 Capital Improvement Fund (328) budget; and

WHEREAS, the total grant funding awarded for the Project is $1,498,650; and

WHEREAS, it is in the best interest of the City to use Washington State grant monies to finance capital facilities improvements.

NOW, THEREFORE, THE CITY COUNCIL OF THE CITY OF AUBURN, WASHINGTON, RESOLVES as follows:

Section 1. The Mayor is authorized to execute and administer the grant agreements with the Washington State Department of Commerce (WSDOC) for a total of $1,498,650 or any other amount authorized by WSDOC for this Project.

Section 2. The Mayor is authorized to negotiate, enter, and administer agreements to spend the grant funds for the Projects, and to implement other administrative procedures necessary to carry out the directives of this legislation.

Section 3. That this Resolution shall take effect and be in full force on passage and signatures.

Dated and Signed: _____

CITY OF AUBURN

_____
NANCY BACKUS, MAYOR

ATTEST:

_____
Shawn Campbell, MMC, City Clerk

APPROVED AS TO FORM:

_____
Jason Whalen, City Attorney