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## PREDICTIVE PREPARATION FOR ENERGY DISRUPTION EVENT

### Abstract

An energy storage system includes an energy distribution system. A battery system is connected to, and configured to provide energy to, the energy distribution system. The battery system includes an energy storage system and a controller. The controller includes a memory storing instructions for causing the vehicle to respond to receiving a notice of an expected energy disruption event at the controller by identifying a severity of the expected energy disruption event, a type of the expected energy disruption event, and a time until an occurrence of the expected energy disruption event using the controller, determining a target charge level of the vehicle battery system based on at least one of the severity, type, and time until the expected energy disruption event and charging the vehicle battery system to the target charge level.

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## Background/Summary

INTRODUCTION

[0001] The subject disclosure relates to providing stored energy from a vehicle to a building, and more particularly to a system and process for preparing a vehicle to provide energy to a building ahead of an expected upcoming energy disruption event.

[0002] Electric vehicles typically include large capacity energy storage systems (e.g., batteries) to ensure that the vehicle is capable of meeting or exceeding desired ranges. In some configurations, the large capacity energy storage systems can be configured to allow energy to be transferred from the vehicle to an exterior system, such as a building energy system, in addition to receiving energy from exterior systems as the vehicle does while charging.

[0003] Accordingly, it is desirable to identify when a building system may benefit from receiving energy from a vehicle and to prepare the vehicle to transfer energy from the vehicle battery to the building system.

SUMMARY

[0004] In one exemplary embodiment a method for providing energy to an energy distribution system includes receiving a notice of an expected energy disruption event at a battery system controller of a battery system of a vehicle, identifying a severity of the expected energy disruption event, a type of the expected energy disruption event, and a time until an occurrence of the expected energy disruption event using the battery system controller, determining a target charge level of the battery system based on at least one of the severity, type, and time until the expected energy disruption event, and charging the battery system to the target charge level.

[0005] In addition to one or more of the features described herein, the method further includes placing the vehicle in a vehicle-to-building mode in response to the battery system reaching the target charge level before the expected energy disruption event.

[0006] In addition to one or more of the features described herein the method further includes transferring energy from the vehicle to a building in response to the energy disruption event occurring.

[0007] In addition to one or more of the features described herein, the building is a low occupancy residential building.

[0008] In addition to one or more of the features described herein, the method further includes responding to an occurrence of the expected energy disruption event by transferring energy from the battery system to a building energy system.

[0009] In addition to one or more of the features described herein, determining a target charge level comprises accessing a locally stored lookup table, the locally stored lookup table correlating the type of the expected energy disruption event and the severity of the expected energy disruption event with a set of target charge levels.

[0010] In addition to one or more of the features described herein, the locally stored lookup table further includes user defined flags corresponding to each severity of each type of energy disruption event, and wherein a user defined flag determines whether charging the vehicle to the target charge level occurs automatically, occurs after a user notification and authorization, or does not occur.

[0011] In addition to one or more of the features described herein, the target charge defined in the locally stored lookup table are locked for vehicle operators.

[0012] In addition to one or more of the features described herein, the method further includes updating the time until the expected energy disruption event in response to receiving an updated notice of the expected energy disruption event.

[0013] In addition to one or more of the features described herein, receiving the notice of an expected energy disruption event comprises receiving information from a central server, and

wherein the central server is in communication with at least one exterior energy disruption event monitoring service.
[0014] In addition to one or more of the features described herein, the expected energy disruption event is a weather event, and the notice of the expected energy disruption event is based at least in part on a weather forecast.
[0015] In addition to one or more of the features described herein, the method further includes adjusting a charging rate of the vehicle battery system based at least in part on the time until the expected energy disruption event and the target charge level.
[0016] In another exemplary embodiment an energy storage system includes. An energy distribution system. A battery system is connected to, and configured to provide energy to, the energy distribution system. The battery system includes an energy storage system and a controller. The controller includes a memory storing instructions for causing a vehicle to respond to receiving a notice of an expected energy disruption event at the controller by identifying a severity of the expected energy disruption event, a type of the expected energy disruption event, and a time until an occurrence of the expected energy disruption event using the controller, determining a target charge level of the battery system based on at least one of the severity, type, and time until the expected energy disruption event and charging the battery system to the target charge level.
[0017] In addition to one or more of the features described herein, the memory further stores instructions for causing the vehicle to enter in a vehicle-to-building mode in response to the battery system reaching the target charge level before the expected energy disruption event.
[0018] In addition to one or more of the features described herein, the memory further stores instructions for causing a transfer of energy from the vehicle to the building in response to the expected energy disruption event occurring.
[0019] In addition to one or more of the features described herein, determining a target charge level comprises accessing a locally stored lookup table, the locally stored lookup table correlating the type of the expected energy disruption event and the severity of the expected energy disruption event with a set of target charge levels.
[0020] In addition to one or more of the features described herein, a locally stored lookup table further includes user defined flags corresponding to each severity of each type of energy disruption event, and wherein a user defined flag determines whether charging the battery system of the vehicle to the target charge level occurs automatically, occurs after a user notification and authorization, or does not occur.
[0021] In addition to one or more of the features described herein, receiving the notice of an expected energy disruption event comprises receiving information from a central server, and wherein the central server is in communication with at least one exterior energy disruption event monitoring service.
[0022] In addition to one or more of the features described herein, the energy storage system further includes adjusting a charging rate of the battery system based at least in part on the time until the expected energy disruption event and the target charge level.
[0023] In addition to one or more of the features described herein, the energy storage system is one of a vehicle and a component of a vehicle, and wherein the energy distribution system includes a connection to at least one electric propulsive motor for the vehicle.
[0024] The above features and advantages, and other features and advantages of the disclosure are readily apparent from the following detailed description when taken in connection with the accompanying drawings.

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## Description

## BRIEF DESCRIPTION OF THE DRAWINGS

[0025] Other features, advantages and details appear, by way of example only, in the following detailed description, the detailed description referring to the drawings in which:

[0026] FIG. **1** is a top view of a motor vehicle including a battery assembly or system and a battery charging system, in accordance with an exemplary embodiment;

[0027] FIG. **2** depicts a block diagram of communications between systems for enabling a vehicle to prepare for an expected energy disruption event;

[0028] FIG. **3** depicts a lookup table of vehicle responses to an identified expected energy disruption event;

[0029] FIG. **4** depicts a process for responding to an identified upcoming energy disruption event;

[0030] FIG. **5** depicts an internal controller process for charging a vehicle battery to prepare for an identified upcoming energy disruption event; and

[0031] FIG. **6** depicts a lookup table of target charge levels for various exemplary expected energy disruption events.

## DETAILED DESCRIPTION

[0032] The following description is merely exemplary in nature and is not intended to limit the present disclosure, its application or uses. It should be understood that throughout the drawings, corresponding reference numerals indicate like or corresponding parts and features.

[0033] In accordance with an exemplary embodiment methods, devices and systems are provided for controlling charging of a battery system, such as an electric vehicle or hybrid vehicle battery system. The embodiments may be applicable to various charging processes, such as conventional charging and DC fast charging (DCFC).

[0034] In an embodiment, an electric vehicle includes a large capacity energy storage system, such as a battery. The large capacity energy storage system can be configured to receive energy from an exterior system through a charge port, or to return energy to the exterior system through the charge port. A battery system controller (alternately referred to as a controller) controls the charging or discharging operations of the large capacity energy system.

[0035] The controller is in communication with one or more exterior systems and is configured to receive a notification of an expected event that may disrupt the flow of energy to the exterior system connected to the charge port. These events are referred to herein as “expected energy disruption events”, and can include any expected events that may result in power loss or disruption to the connected exterior system. In some examples, the expected energy disruption events include weather (e.g., wind storms, blizzards, floods, etc.), scheduled blackouts/rolling blackouts, and/or any similar type of event.

[0036] Also included on the controller is a memory configured to cause the controller to respond to receiving a notification of the expected energy disruption event by identifying a target charge level for the battery system based on the expected energy disruption event type and severity and charging the battery system to the target charge level ahead of the expected energy disruption event. Once charged to the target charge level, the controller places the battery system in a vehicle-to-building (V2H) mode and the battery system is prepared to provide energy to the building on occurrence of the expected energy disruption event. When the expected energy disruption event occurs, the vehicle provides power from the battery system to the building energy distribution system, thereby allowing electrical systems within the building to continue operating throughout the energy disruption event.

[0037] Embodiments described herein present numerous advantages and technical effects. In some examples, the system is capable of anticipating inclement weather with a high risk of causing a power outage and aiding the customer in assuring their vehicle is as charged as possible before the arrival of the inclement weather. In addition, by using this system the vehicle is prepared to trigger a V2H discharge session immediately, and the user is not required to manually set up the V2H session after the energy disruption event has already occurred or is ongoing.

[0038] The embodiments are not limited to use with any specific vehicle and may be applicable to various contexts. For example, embodiments may be used with automobiles, trucks, aircraft, construction equipment, farm equipment, automated factory equipment and/or any other device or system including large capacity energy storage systems that are able to return energy to an exterior energy system. In non-vehicle examples, the systems and processes function identically and the terms “vehicle to building” and “V2H” encompass similar systems for providing energy from a component with a large capacity energy storage system to an exterior energy system. As used throughout, the terms “vehicle to building” and “V2H” are not limited to vehicle based applications.

[0039] FIG. **1** shows an embodiment of a motor vehicle **10**, which includes a vehicle body **12** defining, at least in part, an occupant compartment **14**. The vehicle body **12** also supports various vehicle subsystems including a propulsion system **16**, and other subsystems to support functions of the propulsion system **16** and other vehicle components, such as a braking subsystem, a suspension system, a steering subsystem, a fuel injection subsystem, an exhaust subsystem and others.

[0040] The vehicle **10** may be an electrically powered vehicle (EV) or a hybrid vehicle. In an embodiment, the vehicle **10** is an electric vehicle including at least one electric motor assembly. For example, the propulsion system **16** includes a first electric motor **20** and a second electric motor **21**. The motors **20** and **21** may be configured to drive wheels **30**, **32** on opposing sides of the vehicle **10**. Any number of motors positioned at various locations may be used.

[0041] The vehicle **10** includes a battery system **22**, which may be electrically connected to the motors **20** and **21** and/or other components, such as vehicle electronics. The battery system **22** may be configured as a rechargeable energy storage system (RESS).

[0042] In an embodiment, the battery system **22** includes a battery assembly such as a high voltage battery pack **24**. In alternate examples, alternative large capacity energy storage systems may be utilized in the same manner as the high voltage battery pack **24**. The battery system **22** may also include RESS controller, referred to herein as controller **26**.

[0043] The controller **26** is configured to communicate with one or more exterior systems, including a controller **42** of an exterior energy source **40**. In some examples, the controller **26** is also able to communicate with one or more remote data systems via internet connections.

[0044] The vehicle **10** may include a charging system that can be used to charge the battery pack **24** and/or used for supplying power from the battery pack **24** to charge another energy storage system (e.g., vehicle-to-building charging). The charging system can, in some examples, include an onboard charging module (OBCM) that is electrically connected to a charge port **50**. The charge port **50** can be connected to the exterior energy source **40** to facilitate the exchange of electrical energy.

[0045] In an embodiment, the vehicle **10** includes a charging control system within the controller **26** configured to identify upcoming expected energy disruption events for the exterior energy source **40** and place the battery system **22** in a state where the battery system **22** is prepared to transfer energy from the vehicle **10** to the exterior energy source **40** during an energy disruption event. The controller **26** is configured to receive information identifying the expected energy disruption event via any established communication. The information can either be a direct instruction from a central data server (e.g., a backend source), or indirect information from which the controller **26** infers an expected energy disruption event is pending (e.g., a weather report, rolling blackout schedule, etc.).

[0046] With continued reference to FIG. **1**, FIG. **2** depicts a block diagram **100** of communications between systems, with the communications enabling the vehicle **10** to prepare for an expected energy disruption event. In the example, the vehicle **10** is in reciprocal (two-way) communication with an exterior energy source **40** (e.g., a home charging unit), a remote data server **102**, and a customer controlled application **104** (e.g., a vehicle/charging control phone application.) The remote data server **102** is also in reciprocal communication with the customer controlled application **104**, and in a one way communication with an information service **106**. The information service **106** is able to provide either direct notification of an upcoming expected energy disruption event (e.g. a planned blackout) or provide information from which an upcoming expected energy disruption event may be derived (e.g., a weather forecasting service). In some examples, the one way communication between the remote data server **102** and the information service **106** can be preceded by a request for information initiated by the remote data server **102**. In other examples, the one way communication between the remote data server **102** and the information service **106** can be a continuous or periodic stream of information provided by the information service **106** (e.g., a weather forecast subscription).

[0047] The remote data server **102** is configured to, among other functions, analyze information received from the information service **106** and identify any expected energy disruption events, as well as any corresponding information that may impact the likelihood or severity of an identified expected energy disruption event. By way of example, the remote data server **102** may receive a weather forecast and identify an upcoming weather event as well as a time until the weather event and an expected severity of the weather event.

[0048] Once identified, the expected energy disruption event information is provided to either the vehicle **10** directly via the two way communication (see FIG. **2**) connecting the vehicle **10** to the remote data server **102** or indirectly through the customer controlled application **104**. Upon receipt of the information identifying an upcoming expected energy disruption event, the controller **26** in the vehicle **10** consults a lookup table **200** (see FIG. **3**, discussed herein) to determine how, and when, to respond to the identified expected energy disruption event.

[0049] With continued reference to FIGS. **1** and **2**, FIG. **3** illustrates the lookup table **200** in one example. In some examples, the lookup table **200** can be locally stored within a controller of the vehicle **10**. The lookup table **200** includes a listing of possible events **202** and a corresponding chart **204** of severities of the possible events **202**. In the example chart **204**, the severities are broken down into three severity categories **212**, **214**, **216**: advisory, watch, and warning. Alternative examples can include more, less or different severity categories **212**, **214**, **216** depending on the specific implementation. Within each category the corresponding expected event of the possible events **202** is assigned one of three possibilities. Each of the entries includes a default possibility, however the possibilities can be configured by the end user to meet the end user's desired preferences. In one example, the default possibility is to require confirmation from the user for every possible event **202** until the user has indicated to the contrary.

[0050] In a first case, the event and the severity category are assigned “ignore”. When a possible event **202** and severity category **212**, **214**, **216** are assigned “ignore”, the controller **26** does not prepare to provide power to the exterior energy source **40** as the vehicle **10** operator has previously indicated that they do not wish to prepare to provide power to the exterior source **40** in this event.

[0051] In a second case, the possible event **202** and the severity category **212**, **214**, **216** are assigned “confirm”. When a possible event **202** and severity category **212**, **214**, **216** are assigned confirm, the controller **26** communicates through the customer controlled application **104** with the end user to confirm whether the user wishes prepare the vehicle **10** to provide power to the exterior energy source **40** when the expected energy disruption event (possible event **202**) occurs. The controller **26** then follows the user's selection. When the user declines to provide a selection and/or does not respond to the notification within a predefined time period, the controller **26** defaults to preparing the vehicle **10** to provide energy to the exterior energy source **40**.

[0052] In a third case, the possible event **202** and the severity category **212**, **214**, **216** are assigned to automatically prepare the battery system **22** to provide power to the exterior energy source **40** in preparation for the occurrence of the expected energy disruption event without input from the user.

[0053] While the exemplary possible events **202** illustrated in the lookup table **200** includes snow, fire, flood, tornado, wind and hurricanes, it is understood that this list is exemplary in nature and not exhaustive. Practical implementation may include more, or less, possible events **202** and the possible events **202** may not be limited to weather events.

[0054] With continued reference to FIGS. **1-3**, FIG. **4** illustrates a process **300** for responding to an identified upcoming energy disruption event where the lookup table **200** of FIG. **3** indicates 'confirm' for the event. The example expected energy disruption event of FIG. **4** is a weather event, however the same process would be applied for any other type of expected energy disruption event. Except where indicated otherwise, all decisions and processes are performed by the controller **26** within the vehicle battery system **22**.

[0055] Initially, the controller **26** receives a notification of a forecasted weather event that includes a probability of energy disruption at block **302**. The forecasted weather event is, in one example, a service report of a severe weather event from a national weather service. In alternative examples, the report can be from any other forecasting service including private services, public services, and manual reports entered at the remote data server **102**. Upon receiving the notification, the controller **26** identifies whether the expected energy disruption is expected to occur more than 24 hours from the present time, within 24 hours but longer than a time required to prepare the vehicle for a V2H mode (alternatively phrased as a "reaction time"), or shorter than the reaction time.

[0056] When the expected energy disruption event is longer than 24 hours away, the process **300** proceeds to block **304** where the process checks to ensure the expected energy disruption event is greater than 24 hours away, and then to block **306**. At block **306**, the controller **26** provides a notification to the end user through the customer controlled application **104** that an energy disruption event is expected to occur within X days. The controller **26** then requests that the end user confirm if the vehicle **10** settings should be overridden by the process **300** at a check **308**. In one example, this confirmation is performed by consulting the lookup table **200**. If the end user indicates that the process **300** should not be overridden, the process **300** ends at block **310**, and the vehicle **10** is not configured to provide energy to the exterior energy system **40**.

[0057] If the end user indicates that the process **300** should be overridden at check **308**, then the process **300** waits until 24 hours before the expected energy disruption event and proceeds to block **312**. Similarly, when the initial receipt of the notification occurs within 24 hours of the expected energy disruption event and further away than the reaction time, the process **300** moves from the initial block **302** to block **312**.

[0058] At block **312**, the process **300** identifies that the expected energy disruption event is within 24 hours away, but further away than the reaction time, and proceeds to block **314**.

[0059] At block **314**, the process **300** begins a countdown timer to the edge of the reaction time. By way of example, if it will take 2 hours to prepare the vehicle **10** for the expected energy disruption event, and the event is 24 hours away, a 22 hour countdown timer is initiated. During the countdown, the process **300** additionally monitors vehicle statuses **316** and maintains communication with the remote data server **102** and monitors for updates to the expected arrival time of the expected energy disruption event.

[0060] As the countdown continues, the duration of the countdown is continuously updated based on the vehicle **10** states from block **316** and any updated arrival time of the expected energy disruption event at a block **318**. The updating is continuously iterated until the reaction time is reached, when the process **300** proceeds to block **324**.

[0061] If communication with the remote data server **102** is lost or interrupted at block **320**, the process **300** continues the countdown to the reaction time using the most recently received information at block **322**.

[0062] At block **324**, when the reaction time is reached and/or when initial notification occurs within the reaction time, the process **300** notifies the customer an energy disruption event is near and instructs the end user to plug the charge port **50** of the vehicle **10** into the exterior energy source **40**, and the vehicle **10** is connected to the exterior energy source **40** at block **326**.

[0063] Once connected, the process **300** checks to determine if approval is needed at a check **328**.

The check **328** is performed by consulting the lookup table **200**, and identifying the type and severity **212**, **214**, **216** of the expected energy disruption event. If no approval is needed, a second check **330** occurs to determine the default action to be performed. If the lookup table **200** indicates that the default action is to ignore the expected energy disruption event, the process **300** takes no further action at block **332**. If the default action is to activate the V2H systems and prepare to provide power to the building, the process **300** proceeds to block **334**, where the controller **26** initiates the V2H response (see: FIG. **4**) at block **334**.
[0064] If approval is needed at check **328**, the process **300** provides a notification to the end user through the customer controlled application **104**, and the customer either accepts the reaction (block **336**) declines the reaction (block **338**) or does not respond (block **340**). When the user either accepts or does not respond, the controller initiates the V2H response at block **334**. When the user declines at block **338**, the process **300** takes no action, at block **332**.
[0065] With continued reference to FIGS. **1-4**, FIG. **5** illustrates the process **400** for initiating the V2H reaction upon completion of the process **300** illustrated in FIG. **4**. Upon authorization of and initiation of the V2H process **400** at block **402**, if the vehicle **10** standard charging operation is set to a delayed mode via authorization (block **402**), then the controller **26** continues to calculate the time durations to schedule charging of the battery system **22** to the estimated charge levels at block **404**. Upon authorization of and initiation of the V2H process **400** at block **402**, if the vehicle **10** standard charging operation is set to be immediate charge mode (block **405**), then the V2H process **400** charges at block **407** and proceeds to block **416**.
[0066] After the durations to each charge level have been determined, the process **400** determines the target charge level for the battery system **22**, with the target charge level corresponding to the type of possible event **202** and severity category **212**, **214**, **216** of the expected energy disruption event at block **406**. In one example, the target charge level is determined using a second lookup table **500**, illustrated in FIG. **6**. In some examples, the second lookup table **500** can be locally stored within a controller of the vehicle **10**. The second lookup table **500** includes the type of possible event **202** and severity category **212**, **214**, **216** of the first lookup table **200**, with the entries for each type of possible event **202** and severity category **212**, **214**, **216** indicating a target charge level (e.g. a targeted state of charge) of the battery system **22**. The target charge level is an amount of charge within the battery system **22** required to ensure that the battery system **22** can provide sufficient power to the exterior energy source **40** for an expected duration of the expected energy disruption event. In one example, the entries in the second lookup table **500** are set by the remote data server and cannot be changed by an end user. This configuration is referred to as being locked for vehicle operators.
[0067] When the current state of charge of the battery system **22** is greater than the target charge level at block **408**, the controller **26** causes the process **400** to cease charging and proceeds to wait for a time until the expected energy disruption event to occur has elapsed at block **410**.
[0068] When the current state of charge of the battery system **22** is less than the target charge level, block **412**, the controller **26** causes the battery system **22** to initiate charging through the charge port **50** and block **414**, and the charging continues until either the target charge level is reached, or the time until the expected energy disruption event has elapsed.
[0069] At block **416** the time until the expected energy disruption event elapses. In the event that the expected energy disruption event has not occurred when the time elapses, the process **400** branches into two possible routes, depending on whether the target charge level has been reached (block **418**) or has not been reached (block **420**). When the target charge level has been reached, the controller **26** causes the vehicle **10** to prepare to enter a V2H session, and waits in standby until either the expected energy disruption event occurs, or the controller **26** is informed that the expected energy disruption event will not occur at block **422**.
[0070] When the battery system **22** is not charged to the full charge level (block **420**), the controller **26** causes the battery system **22** to continue charging until the target charge level is reached (block

**421**), and then proceeds to block **422** when the target charge level is reached, and the expected energy disruption event has not yet occurred. Should the energy disruption event occur while the battery system **22** is still charging to the target charge level, an end user/vehicle **10** operator will manually trigger the V2H operations and the process **400** moves to block **422**.
[0071] Once switched into the V2H mode, the controller **26** causes the battery system **22** to wait for an occurrence of the expected energy disruption event in standby mode. When the expected energy disruption event occurs, the controller **26** causes the battery system **22** to discharge energy from the vehicle **10** to the exterior energy source **40** for either a duration of the energy disruption event or until a minimum battery system charge **22** is reached at block **424**, after which the process returns to standard charging operations at block **426**.
[0072] When the expected energy disruption event does not occur, or is downgraded such that no disruption is expected, the controller **26** causes the battery system **22** to bypass block **424** and go straight to block **426**.
[0073] While illustrated and described above with regards to a generic energy distribution systems, it is appreciated that one particularly useful embodiment utilizes a passenger vehicle as the vehicle **10**, and a single family residential house (or other low occupancy residential building) as the building including the exterior energy source **40**. This particular embodiment allows an end user to utilize the high capacity energy storage contained within their vehicle **10** to provide emergency power to their home during a weather related blackout. Further the process described herein allows for this function to be performed seamlessly without requiring the user to activate the system, or perform other administrative tasks required to enable the system after an energy disruption to their home has already occurred.
[0074] The terms “a” and “an” do not denote a limitation of quantity, but rather denote the presence of at least one of the referenced item. The term “or” means “and/or” unless clearly indicated otherwise by context. Reference throughout the specification to “an aspect”, means that a particular element (e.g., feature, structure, step, or characteristic) described in connection with the aspect is included in at least one aspect described herein, and may or may not be present in other aspects. In addition, it is to be understood that the described elements may be combined in any suitable manner in the various aspects.
[0075] When an element such as a layer, film, region, or substrate is referred to as being “on” another element, it can be directly on the other element or intervening elements may also be present. In contrast, when an element is referred to as being “directly on” another element, there are no intervening elements present.
[0076] Unless specified to the contrary herein, all test standards are the most recent standard in effect as of the filing date of this application, or, if priority is claimed, the filing date of the earliest priority application in which the test standard appears.
[0077] Unless defined otherwise, technical and scientific terms used herein have the same meaning as is commonly understood by one of skill in the art to which this disclosure belongs.
[0078] While the above disclosure has been described with reference to exemplary embodiments, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from its scope. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the disclosure without departing from the essential scope thereof. Therefore, it is intended that the present disclosure not be limited to the particular embodiments disclosed, but will include all embodiments falling within the scope thereof.

## Claims

**1**. A method for providing energy to an energy distribution system, the method comprising: receiving a notice of an expected energy disruption event at a battery system controller of a battery system of a vehicle; identifying a severity of the expected energy disruption event, a type of the expected energy disruption event, and a time until an occurrence of the expected energy disruption event using the battery system controller; determining a target charge level of the battery system based on at least one of the severity, type, and time until the expected energy disruption event; and charging the battery system to the target charge level.

**2**. The method of claim 1, further comprising placing the vehicle in a vehicle-to-building mode in response to the battery system reaching the target charge level before the expected energy disruption event.

**3**. The method of claim 2, further comprising transferring energy from the vehicle to a building in response to the energy disruption event occurring.

**4**. The method of claim 3, wherein the building is a low occupancy residential building.

**5**. The method of claim 1, further comprising responding to an occurrence of the expected energy disruption event by transferring energy from the battery system to a building energy system.

**6**. The method of claim 1, wherein determining a target charge level comprises accessing a locally stored lookup table, the locally stored lookup table correlating the type of the expected energy disruption event and the severity of the expected energy disruption event with a set of target charge levels.

**7**. The method of claim 6, wherein the locally stored lookup table further includes user defined flags corresponding to each severity of each type of energy disruption event, and wherein a user defined flag determines whether charging the vehicle to the target charge level occurs automatically, occurs after a user notification and authorization, or does not occur.

**8**. The method of claim 6, wherein the target charge defined in the locally stored lookup table are locked for vehicle operators.

**9**. The method of claim 1, further comprising updating the time until the expected energy disruption event in response to receiving an updated notice of the expected energy disruption event.

**10**. The method of claim 1, wherein receiving the notice of an expected energy disruption event comprises receiving information from a central server, and wherein the central server is in communication with at least one exterior energy disruption event monitoring service.

**11**. The method of claim 1, wherein the expected energy disruption event is a weather event, and the notice of the expected energy disruption event is based at least in part on a weather forecast.

**12**. The method of claim 1, further comprising adjusting a charging rate of vehicle battery system based at least in part on the time until the expected energy disruption event and the target charge level.

**13**. An energy storage system comprising: an energy distribution system; a battery system connected to, and configured to provide energy to, the energy distribution system, the battery system including an energy storage system and a controller, and wherein the controller includes a memory storing instructions for causing a vehicle to respond to receiving a notice of an expected energy disruption event at the controller by identifying a severity of the expected energy disruption event, a type of the expected energy disruption event, and a time until an occurrence of the expected energy disruption event using the controller, determining a target charge level of the battery system based on at least one of the severity, type, and time until the expected energy disruption event and charging the battery system to the target charge level.

**14**. The energy storage system of claim 13, wherein the memory further stores instructions for causing the vehicle to enter in a vehicle-to-building mode in response to the battery system reaching the target charge level before the expected energy disruption event.

**15**. The energy storage system of claim 14, wherein the memory further stores instructions for causing a transfer of energy from the battery system to the building in response to the expected energy disruption event occurring.

**16**. The energy storage system of claim 13, wherein determining a target charge level comprises accessing a locally stored lookup table, the locally stored lookup table correlating the type of the expected energy disruption event and the severity of the expected energy disruption event with a set of target charge levels.

**17**. The energy storage system of claim 16, wherein the locally stored lookup table further includes user defined flags corresponding to each severity of each type of energy disruption event, and wherein a user defined flag determines whether charging the battery system to the target charge level occurs automatically, occurs after a user notification and authorization, or does not occur.

**18**. The energy storage system of claim 13, wherein receiving the notice of an expected energy disruption event comprises receiving information from a central server, and wherein the central server is in communication with at least one exterior energy disruption event monitoring service.

**19**. The energy storage system of claim 13, further comprising adjusting a charging rate of the battery system based at least in part on the time until the expected energy disruption event and the target charge level.

**20**. The energy storage system of claim 13, wherein the energy storage system is one of a vehicle and a component of a vehicle, and wherein the energy distribution system includes a connection to at least one electric propulsive motor for the vehicle.