Residential Level 2 EVSE Installation in New Brunswick

Worked problems, plain-language explanations, Code navigation and field-ready learning for electricians and apprentices

AUDIENCE	CASE	EDITION BASIS
Construction electricians and registered apprentices	Representative 40 A hardwired residential EVSE	NB adoption of C22.1-24; verify current requirements

SAFETY AND SCOPE This module teaches reasoning and planning. It is not permission for unsupervised work, energized work or work outside a person's licence, registration, supervision or demonstrated competence. Follow GoRight safety procedures and the authority having jurisdiction.

Learning outcomes

- Explain what the EVSE does and why the vehicle contains the AC charger.
- Translate EVSE output current into branch-circuit, conductor and service-load decisions.
- Perform transparent power, energy, charging-time and voltage-drop calculations.
- Evaluate panel capacity, wiring route, environment, product approval, permits and commissioning.
- Recognize when an EV energy management system may avoid a service upgrade.
- Document a safe, inspectable installation and explain it to a customer or apprentice.

TRAINING CASE The worked installation is a realistic New Brunswick teaching scenario built around a Saint John-region dwelling. Every design input is stated so apprentices can follow the reasoning, recalculate changed conditions and distinguish a training assumption from a verified field fact.

1. New Brunswick regulatory foundation and design principles

A residential Level 2 EVSE installation in New Brunswick is designed from the currently adopted Canadian Electrical Code, the province's modifications and permit requirements, the approved equipment markings and the manufacturer's Canadian instructions. The installation is not selected from a generic cable-size chart or from available breaker spaces alone.

New Brunswick design principle	Field meaning	Primary reference path
Use the adopted Code edition.	Confirm the edition and provincial modifications before design or quotation.	NB Regulation 84-165; C22.1-24 and applicable errata.
Calculate before installing.	Panel space does not establish service capacity. Complete the applicable Section 8 load analysis.	CEC Section 8; EVEMS/load-control provisions where applicable.
Treat EVSE load correctly.	Translate the equipment's maximum continuous output into branch-circuit, conductor and OCPD decisions.	CEC Sections 4, 8, 12, 14 and 86; equipment nameplate.
Use approved equipment.	Verify the exact model, certification mark, voltage/current ratings, enclosure and Canadian instructions.	NB Regulation 84-165; CEC Section 2; CSA C22.2 No. 280 context.
Select wiring from job facts.	Account for terminal temperature, conductor material, installation method, correction factors, environment and voltage drop.	CEC Sections 4 and 12; manufacturer terminal limitations.
Obtain the required permit first.	A residential installation above 5 kW requires an NB wiring permit; this 9.6 kW case exceeds that threshold.	NB wiring-permit requirements and project permit conditions.
Inspect, commission and document.	Inspection is an independent check, while workmanship, settings, torque, testing and records remain the contractor's responsibility.	Technical Inspection Services requirements; manufacturer commissioning instructions.

NB FIELD RULE Start every job file with five verified items: adopted Code edition, equipment approval, service-load calculation, permit requirement and manufacturer instructions. If any one is missing, the installation design is not ready for construction.

2. System picture: what actually charges the battery?

For AC Level 2 charging, the wall unit is EV supply equipment (EVSE). It controls and safeguards the delivery of AC power. The vehicle's on-board charger converts AC to DC and manages battery charging.

The EVSE and vehicle communicate an allowable current; the vehicle must not draw more than the offered limit.

Part	Function	Electrician’s concern
Utility and dwelling service	Supplies 120/240 V single-phase power.	Available capacity, service condition and calculated demand.
Panel and breaker	Provides switching and overcurrent protection.	Rating, spaces, interrupting rating, terminal limits and compatibility.
Branch conductors and raceway/cable	Carry continuous charging current.	Ampacity, voltage drop, environment, support, protection and terminations.
EVSE	Controls current availability and detects defined faults.	Certification, nameplate, settings, enclosure, instructions and mounting.
Vehicle inlet/on-board charger	Accepts power and charges battery.	Maximum AC acceptance rate and connector compatibility.
EVEMS, when used	Controls charging to respect available capacity.	Approved equipment, fail-safe operation, sensing and commissioning.

3. Representative New Brunswick field case

Training location: an owner-occupied detached dwelling in the Saint John region. The case is designed to resemble a common attached-garage retrofit while keeping every assumption visible.

Item	Case value	Why it matters
Service	200 A, 120/240 V, single phase	Sets the supply framework; capacity still requires calculation.
Panel	Modern 200 A panel; compatible 2-pole space available	Breaker space is necessary but not sufficient.
Existing calculated demand	126 A before EVSE	Training value assumed from a completed Section 8 calculation.
EVSE	Certified hardwired Level 2 unit; 40 A maximum output	9.6 kW at nominal 240 V; continuous branch-circuit load.
Route	22 m one-way from panel to attached, unheated garage	Drives conductor method, protection and voltage-drop review.
Conductor assumption	No. 8 AWG copper; 75 C rated terminations confirmed	Illustrative only; verify current ampacity rules and installation conditions.
Protection	Compatible 50 A, 2-pole breaker	Derived from continuous-load treatment, subject to equipment instructions.
Environment	Indoor, dry location; no hazardous-location features	Simplifies enclosure and wiring-method decisions.
Permit	Required before work in this case	40 A x 240 V = 9.6 kW, exceeding NB's 5 kW permit threshold.
Connection	Hardwired	Avoids a high-current receptacle interface; follow EVSE instructions.

STOP POINT If the actual service load, conductor conditions, terminal ratings, product approval, environment or manufacturer instructions differ, the design must be recalculated. A "typical" size is never a substitute for the job facts.

4. Site assessment before calculations

- Photograph and record service, meter, panel nameplate, main breaker, bus rating and available spaces.
- Confirm the EV model, daily driving, on-board AC charging limit and customer's future plans.

- Obtain the EVSE model, certification mark, nameplate current, adjustable settings and installation instructions.
- Trace the complete route; identify insulation, finished surfaces, damp/wet areas, physical damage, fire separations and penetrations.
- Identify other major loads and any planned electrification: heat pumps, range, hot tub, generator, solar or storage.
- Determine permit, utility, inspection and shutdown needs before quoting.
- Agree on mounting position, cable reach, snow/vehicle impact risk, network signal and customer handoff.

5. Worked problems

Worked problem 1 - EVSE power

Given: V = 240 V, I = 40 A

Formula: P = V x I

P = 240 x 40 = 9,600 W = 9.6 kW

Answer: The EVSE can deliver about 9.6 kW at nominal voltage.

Plain-language explanation: Power is how fast energy is transferred. A 40 A label is not “40 A per hour.” At 240 V, current and voltage combine to give 9.6 kW. The actual vehicle may draw less.

Code and standards reference: CEC Section 86 (EV charging systems); EVSE nameplate and manufacturer instructions; CSA C22.2 No. 280 product certification context.

Worked problem 2 - Charging energy and time

Battery capacity: 77 kWh

Start = 20%, target = 80%

Battery energy added = 77 x (0.80 - 0.20) = 46.2 kWh

Assume overall AC-to-battery efficiency = 90%

Grid energy = 46.2 / 0.90 = 51.3 kWh

Ideal time = 51.3 / 9.6 = 5.34 h

Answer: Approximately 5.3 hours under these assumptions.

Plain-language explanation: The battery needs 46.2 kWh, but conversion and thermal losses mean the home supplies more. Charging can slow near higher states of charge, at low temperature or when the vehicle limits AC input, so customer estimates should be ranges, not guarantees.

Code and standards reference: NB Power distinguishes 120 V Level 1 from 240 V Level 2 charging; use vehicle and EVSE manufacturer data for actual performance.

Worked problem 3 - Branch-circuit rating for continuous charging

Maximum EVSE output: 40 A

Continuous-load sizing factor: 125%

Minimum circuit basis = 40 x 1.25 = 50 A

Answer: Use a branch circuit designed for at least 50 A, subject to the complete Code and equipment requirements.

Plain-language explanation: Charging can continue for hours. The circuit is intentionally not operated at the full rating of ordinary protective equipment for long periods. The 40 A load occupies 80% of a 50 A circuit.

Code and standards reference: CEC Rule 86-302 treats the connected EVSE load as continuous for Rule 8-104; also review Sections 4, 12 and 14 and the marked terminal/equipment ratings.

5. Worked problems - continued

Worked problem 4 - Simplified service-capacity screen

Existing dwelling calculated demand: 126 A

EVSE connected load: 40 A

Screened total = 126 + 40 = 166 A

Service rating = 200 A

Apparent margin = 200 - 166 = 34 A

Answer: The illustrative 200 A service passes this simplified screen with 34 A of calculated margin.

Plain-language explanation: The available breaker spaces did not answer this question. A documented Section 8 calculation did. This example starts with an already calculated 126 A value; apprentices must learn the full dwelling calculation separately. If the result exceeds service capacity, investigate EVEMS or a service upgrade rather than simply installing a smaller breaker.

Code and standards reference: CEC Section 8, including the applicable single-dwelling calculation rules and EV load/EVEMS provisions; CEC Section 86. Verify C22.1-24 and NB amendments.

Worked problem 5 - Voltage drop on the 22 m run

One-way length L = 22 m = 0.022 km

Loop length = 2L = 0.044 km

Assumed No. 8 Cu resistance for exercise = 2.5 ohm/km

Loop resistance R = 0.044 x 2.5 = 0.110 ohm

Voltage drop Vd = I x R = 40 x 0.110 = 4.4 V

Percent drop = 4.4 / 240 x 100 = 1.83%

Answer: About 4.4 V, or 1.8%, using the stated resistance assumption.

Plain-language explanation: Current travels out and back, so the length is doubled. The resistance value must come from defensible conductor data and be adjusted for the real temperature and material. Voltage drop affects charging power and heat but does not replace ampacity requirements.

Code and standards reference: CEC Section 8 voltage-drop objectives and Appendix B guidance; Section 4 conductor selection; manufacturer minimum-voltage requirements. Verify the current Code text.

Worked problem 6 - Conductor loss and why torque matters

Loop resistance from Problem 5: 0.110 ohm

Current I = 40 A

Conductor loss P = I squared x R

P = 40 x 40 x 0.110 = 176 W

Answer: Approximately 176 W distributed along the circuit at full output under the exercise assumptions.

Plain-language explanation: Normal conductors have resistance, so some energy becomes heat. A loose terminal concentrates resistance at one small point, creating dangerous local heating. Clean preparation, correct conductor type, listed connectors and manufacturer-specified torque are essential. Never invent a torque value.

Code and standards reference: CEC Sections 4, 12 and 14; equipment markings; breaker, EVSE and connector manufacturer instructions; use a suitable torque tool where specified.

6. Conductor and wiring-method decisions

The case uses No. 8 AWG copper only as a transparent training assumption after confirming 75 C rated terminations and suitable installation conditions. The field decision must be made from the current Code tables, correction/derating rules, actual cable/raceway and equipment markings.

Question	Why it changes the answer
Are both terminals marked for the conductor temperature used?	A conductor's insulation rating does not automatically allow the highest ampacity column.
Is the conductor in cable, raceway, insulation or a bundled group?	Heat dissipation and correction factors can reduce allowable ampacity.
Copper or aluminum?	Ampacity, size, preparation, connector suitability and torque differ.
Indoor dry, damp, wet, underground or outdoors?	Insulation, raceway, fittings and enclosure ratings must suit the environment.
Is physical damage possible?	Garage traffic, storage and vehicles may require guarding or a different route.
How long is the run?	Voltage drop may justify a larger conductor even when ampacity passes.
Does the EVSE require a neutral?	Many hardwired 240 V units do not; never assume - follow the diagram.
Are fire separations penetrated?	Maintain required firestopping and building integrity.

APPRENTICE HABIT Write the conductor decision as a chain: load -> circuit rating -> terminal temperature -> ampacity table -> correction factors -> voltage drop -> wiring method -> environment -> product instructions. If one link is missing, the answer is incomplete.

7. Hardwired or receptacle-connected?

Hardwired EVSE	Receptacle-connected EVSE
Fewer high-current contact interfaces.	Portable or replaceable without opening fixed wiring.
Often avoids receptacle heating and some nuisance interactions.	Requires a correctly configured, high-quality receptacle and plug.
Disconnect rules still require review.	Receptacle and branch protection/GFCI requirements need careful Code review.

Hardwired EVSE	Receptacle-connected EVSE
Installer must follow terminal and conductor instructions.	Repeated plugging, poor contact pressure or low-grade devices can create heat.
Good choice for a dedicated long-term location.	Useful where customer has a compatible cord-connected unit and arrangement.

GFCI DESIGN CHECK Do not apply one protection arrangement to every EVSE. Determine the requirement from the current adopted CEC, connection method, location, EVSE listing and manufacturer instructions. Internal personnel-protection functions do not replace the electrician's obligation to verify all applicable branch-circuit requirements; interacting protective systems must be evaluated and commissioned correctly.

8. Service capacity and EV energy management

A service upgrade is not the automatic answer when the calculated demand is too high. An approved EV energy management system (EVEMS) may reduce, pause or schedule charging so the service remains within its allowable load. This is a design and commissioning task, not merely a “smart charger” marketing feature.

Decision	Use when	Key checks
Install at full 40 A	Calculated capacity and circuit support it.	Document calculation and nameplate setting.
Reduce EVSE setting	Customer accepts slower charging and equipment supports a locked/configured limit.	Setting must be durable, documented and protected from casual change as required.
Install EVEMS	Service capacity is constrained but managed charging is practical.	Approved system, sensing location, fail-safe response, commissioning and customer education.
Upgrade service	Loads, future plans or utility/service condition justify it.	Utility coordination, permit, equipment, cost, downtime and building work.

Worked problem 7 - Managed charging logic

Service limit for control example: 180 A

Measured non-EV load: 158 A

Available current = 180 - 158 = 22 A

EVEMS command: EVSE must not exceed 22 A

If non-EV load rises to 178 A, available = 2 A

System response: pause or reduce charging within approved operating logic

Answer: Charging is dynamically limited to protect the service constraint.

Plain-language explanation: The EV is flexible: it can often charge later or more slowly. The EVEMS must be designed, listed/approved and commissioned for the intended control method; a Wi-Fi schedule alone is not automatically an electrical load-management system.

Code and standards reference: CEC Section 8 EVEMS/load-control provisions and Section 86 branch-circuit provisions; product certification and manufacturer commissioning instructions.

9. Permit and inspection in New Brunswick

- New Brunswick Regulation 84-165 defines the adopted Code as C22.1-24, Canadian Electrical Code, Part I, 26th Edition, including errata and New Brunswick modifications.

- New Brunswick's wiring-permit requirements state that licensed electrical contractors must obtain a permit for construction involving more than 10 outlets or more than 5 kW of load.
- The 40 A, 240 V case is 9.6 kW, so it exceeds the 5 kW threshold. Obtain the permit before construction.
- New Brunswick Technical Inspection Services administers the provincial wiring-permit and electrical-inspection process.
- Permit and inspection requirements do not replace the contractor's obligation to select approved equipment, follow the adopted Code and provide competent workmanship.

FIELD FILE Keep the permit number, scope, EVSE model/certification, load calculation, panel data, circuit design, photos, torque/verification record, commissioning results and inspection outcome together.

10. Installation workflow for the case

1. Confirm scope: Verify vehicle, EVSE, maximum output, location, route, network needs and customer expectations.

2. Verify approval: Check the certification mark, model, ratings, enclosure, conductor/terminal limits and Canadian instructions.

3. Complete design: Finish Section 8 calculation, circuit sizing, conductor/wiring method, voltage drop, breaker compatibility and disconnect review.

4. Permit and plan: Obtain the NB wiring permit; coordinate shutdown, inspection and any utility work.

5. Make safe: Follow hazard assessment, lockout/isolation, test-before-touch and panel-access procedures. Apprentices work under required direct supervision.

6. Install raceway/cable: Protect, support and route conductors; preserve fire separations; avoid damage and moisture traps.

7. Mount EVSE: Use suitable structure and clearances; manage cable reach, connector storage, snow/water and vehicle impact.

8. Terminate: Prepare conductors correctly; use approved connectors; apply specified torque; label the circuit.

9. Verify: Perform visual, continuity/bonding and functional checks with suitable instruments and safe procedures.

10. Commission: Set current limit, test EVSE functions, verify vehicle charging, network/control and EVEMS response if present.

11. Inspect and close: Complete provincial inspection steps, correct deficiencies and deliver customer instructions and records.

11. Commissioning record

Check	Record
Permit / inspection reference	____________________________
EVSE manufacturer, model, serial	____________________________
Certification mark verified	Yes / No / evidence
Supply voltage L-L before charge	________ V
Configured maximum current	________ A
Measured charging current	________ A
Voltage at EVSE under load	________ V
Observed voltage drop	________ V / ________ %

Check	Record
Breaker and conductor	____________________________
Torque applied per instructions	Values / tool / verification record
Bonding and visual checks	Pass / deficiency
EVEMS functional test, if used	Method / result
Customer demonstration	Complete / outstanding
Photos and documents filed	Location / file reference

12. Troubleshooting framework

Symptom	Reasoning path - do not jump to conclusions
Vehicle charges below 40 A	Check vehicle AC limit, state of charge, temperature, EVSE setting, EVEMS command, voltage and communication.
Breaker trips after extended charging	Do not upsize. Check actual current, breaker compatibility, connection heating, conductor conditions, nuisance/protection operation and equipment faults.
EVSE reports ground fault	Follow manufacturer diagnostics; inspect environment, cable/connector, bonding, damage and insulation conditions using safe methods.
Receptacle or plug is hot	Stop use. Inspect device quality, contact condition, torque, conductor, loading and damage; replace only with approved components and correct the cause.
Charging stops when other loads run	Determine whether EVEMS is correctly controlling, service voltage is stable and settings/sensors are commissioned.
Network/app unavailable	Separate electrical charging function from communications; check signal, provisioning, firmware policy and customer network responsibility.

DIAGNOSTIC DISCIPLINE Observe -> make safe -> collect data -> form a hypothesis -> test it -> correct the verified cause -> retest -> document. Parts replacement without evidence is not troubleshooting.

13. Common errors and their lesson

- Choosing breaker and conductor from an internet “typical size” instead of the nameplate and Code.
- Treating open panel spaces as proof of service capacity.
- Assuming every 240 V EVSE requires the same neutral, GFCI or disconnect arrangement.
- Using an uncertified imported charger or failing to verify the exact model.
- Ignoring terminal temperature and torque requirements.
- Allowing a customer-adjustable current setting to exceed the circuit design.
- Routing where cable can be hit by a vehicle, stored materials or snow-removal equipment.
- Skipping load testing, EVEMS commissioning or customer education.
- Calling the wall unit “the charger” without understanding the vehicle’s on-board charger - acceptable in customer conversation, but incomplete technical thinking.

14. Apprentice exercises

1. A 32 A EVSE is installed at 240 V. Calculate output power and the branch-circuit basis using the continuous-load factor.
2. A 48 A EVSE is proposed. Calculate the minimum branch-circuit basis. List three facts that still must be checked before choosing a conductor.
3. An existing calculated demand is 154 A on a 200 A service. Can a 48 A EVSE simply be added? Show the screen and identify two alternatives.
4. A 30 m one-way circuit carries 32 A. Using an exercise resistance of 2.5 ohm/km, calculate loop resistance, voltage drop and percentage at 240 V.
5. Explain why “the charger has built-in ground-fault protection” does not by itself answer whether a GFCI breaker is required.
6. The customer wants the cheapest imported EVSE. State the approval checks and how you would explain the decision.
7. A customer drives 70 km/day and the vehicle uses 20 kWh/100 km. Estimate daily battery energy and time on a 7.68 kW EVSE at 90% efficiency.
8. Write a five-line safe-work plan for adding the breaker and conductors, including apprentice supervision.

15. Answer key

Exercise	Answer
1	Power = 240 x 32 = 7.68 kW. Circuit basis = 32 x 1.25 = 40 A.
2	48 x 1.25 = 60 A. Check terminal ratings, ampacity/correction conditions, wiring method/environment, voltage drop and instructions.
3	154 + 48 = 202 A, so the simplified screen exceeds 200 A. Complete the proper calculation; consider an approved EVEMS, reduced setting or service upgrade.
4	Loop = 0.060 km. R = 0.060 x 2.5 = 0.150 ohm. Vd = 32 x 0.150 = 4.8 V. Percent = 4.8/240 x 100 = 2.0%.
5	Branch protection depends on the current adopted Code, connection method, location, product listing and instructions. Internal protection and branch-circuit protection have different scopes.
6	Verify a certification mark acceptable in NB, exact model, ratings, enclosure and Canadian instructions. Explain that low purchase price cannot justify installing unapproved equipment.
7	Battery energy = 70 x 20/100 = 14 kWh. Grid energy = 14/0.90 = 15.56 kWh. Time = 15.56/7.68 = about 2.0 h.

Exercise	Answer
8	Accept answers that identify hazards, de-energization/isolation, verification, PPE/tools, controlled access and direct supervision consistent with NB requirements and GoRight procedures.

16. Code and standards navigation map

Reference	Use in this module
NB Regulation 84-165	Adopts C22.1-24 with NB modifications; governs approved equipment, licensing, permits and provincial requirements.
CEC Section 2	General rules, approved equipment, markings and installation instructions.
CEC Section 4	Conductor ampacity, temperature limitations and related selection.
CEC Section 8	Calculated loads, circuit loading, dwelling demand and EVEMS/load-control concepts.
CEC Section 10	Grounding and bonding.
CEC Section 12	Wiring methods, support, protection and environment.
CEC Section 14	Protection and control, including overcurrent devices.
CEC Section 26	Installation of electrical equipment and applicable receptacle considerations.
CEC Section 86	EV charging systems: scope, branch circuits, connected load, disconnecting, connection and locations.
CSA C22.2 No. 280	Product safety standard context for conductive AC EVSE.
Manufacturer instructions	Model-specific conductor, terminal, breaker, mounting, environmental, configuration and commissioning requirements.
NB permit conditions / inspector direction	Project-specific administrative and inspection requirements.

COPYRIGHT AND AUTHORITY This module references Code topics and rule numbers for navigation; it does not reproduce the Canadian Electrical Code. The complete official standard, NB amendments, permit conditions and authority interpretations govern.

17. New Brunswick legal and technical references

Government of New Brunswick - Regulation 84-165 - Current consolidated regulation; confirms C22.1-24 adoption and NB modifications.

Government of New Brunswick - Regulation 2026-5 - Filed March 11, 2026; amended the Code definition to C22.1-24 and updated provincial modifications.

Government of New Brunswick - Electrical wiring permits - Permit threshold and application guidance.

Government of New Brunswick - Electrical licences - Contractor/electrician licensing context.

NB Power - Charging at Home - Provincial Level 1 and Level 2 consumer context.

CSA Group - EVSE testing and certification - CSA C22.2 No. 280 product-safety context.

REVISION CONTROL Prepared August 2026. Review whenever New Brunswick adopts a new Code edition, issues an electrical bulletin, changes permit processes, or when EVSE/EVEMS product instructions change.

NB EVSE final release check

- Current NB-adopted Code edition and amendments confirmed.
- Exact EVSE model, certification mark, nameplate and Canadian instructions recorded.
- Section 8 service-load calculation and any EVEMS design documented.
- Branch-circuit rating, conductor selection, correction factors and voltage drop verified.
- Wiring method, enclosure, mounting, mechanical protection and environment checked.
- NB wiring permit obtained before construction when required.
- Terminations completed to marked requirements with torque/verification records retained.
- Commissioning, customer demonstration, inspection outcome and as-installed records closed.