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VIRTUAL CONFERENCE

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IoT Driving Next Generation Solar and EV Charging

KYLE SPORRE, DIGI INTERNATIONAL



IoT Driving Next Gen Solar and EV Charging

■ Solar Energy

- History and progression of solar energy
- Use cases and IoT benefits

■ EV charging

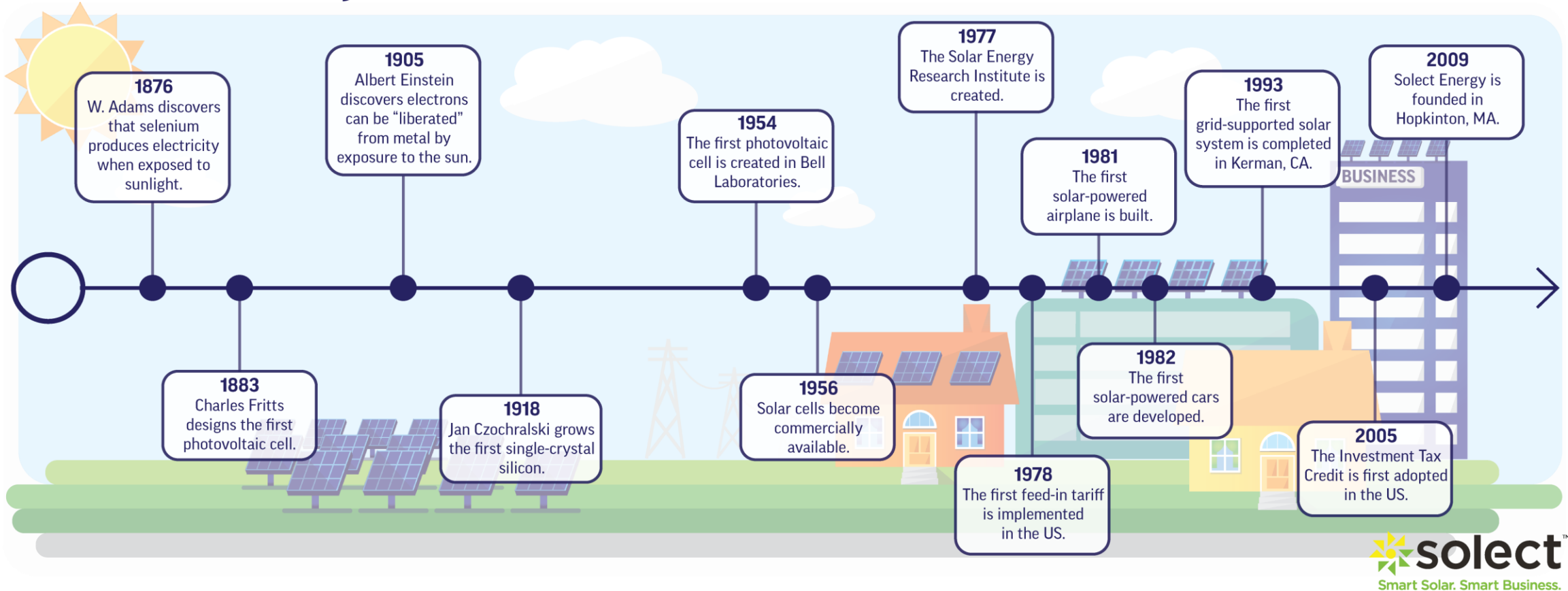
- Market overview
- Architecture and IoT Benefits

■ Connectivity Overview



History of Solar

A Brief History of Solar



<https://solect.com/history-solar-energy/>

Solar Energy Breakthroughs

- Efficiency
- Lithium-ion batteries
- Cost Improvements
- Consumer Adoption
 - 2005: Investment Tax Credit

1970's → 2019

>95% Cost Decrease

Gross Cost Per Watt, by Half Year

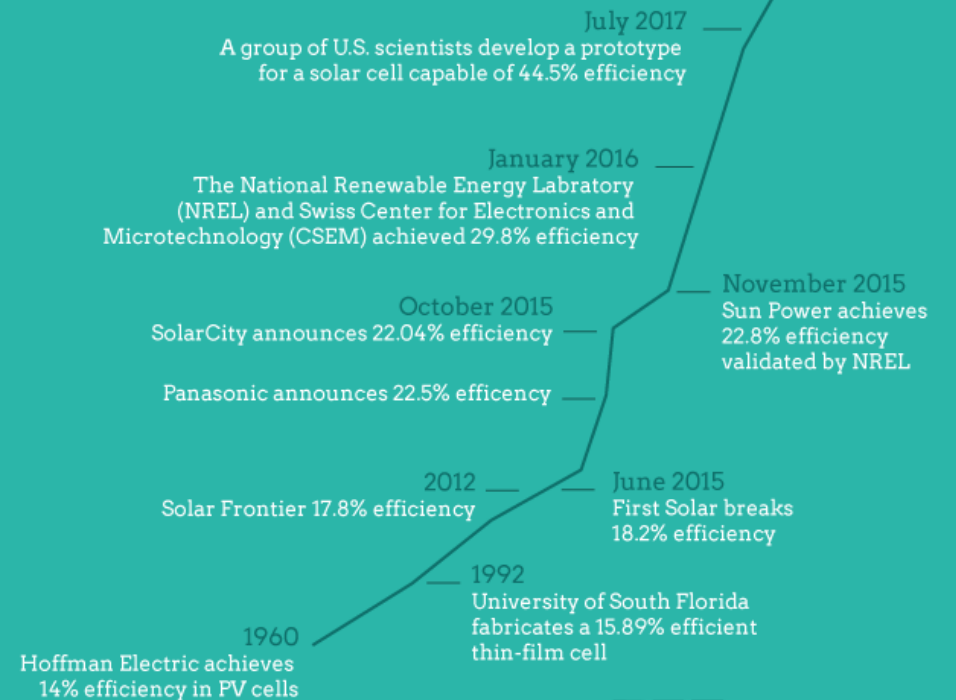


<https://news.energysage.com/solar-panel-efficiency-cost-over-time/>

energysage

Tracking Solar Panel Efficiency

The race to solar panel efficiency has been a long one, but is heating up right now. Take a look at how much the past few years have mattered in the grand scheme of solar innovation.



© EnergySage

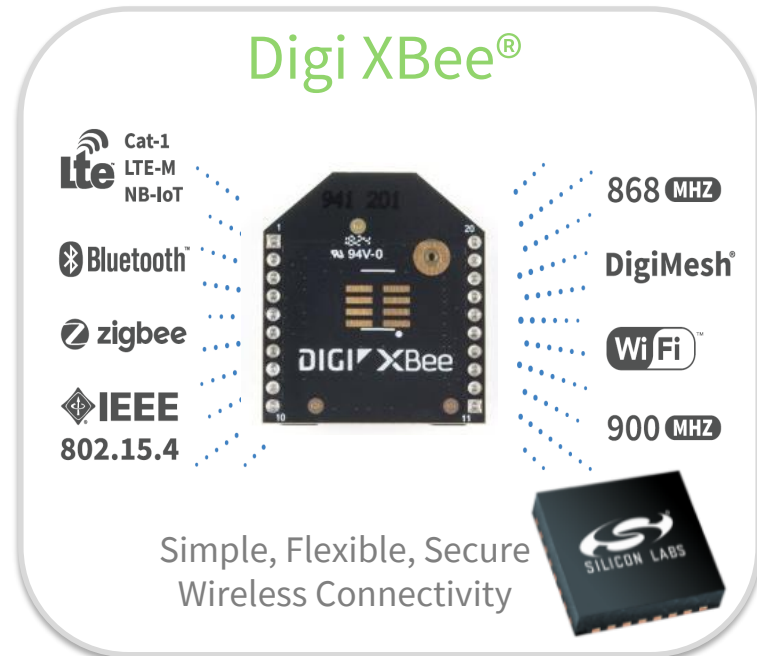
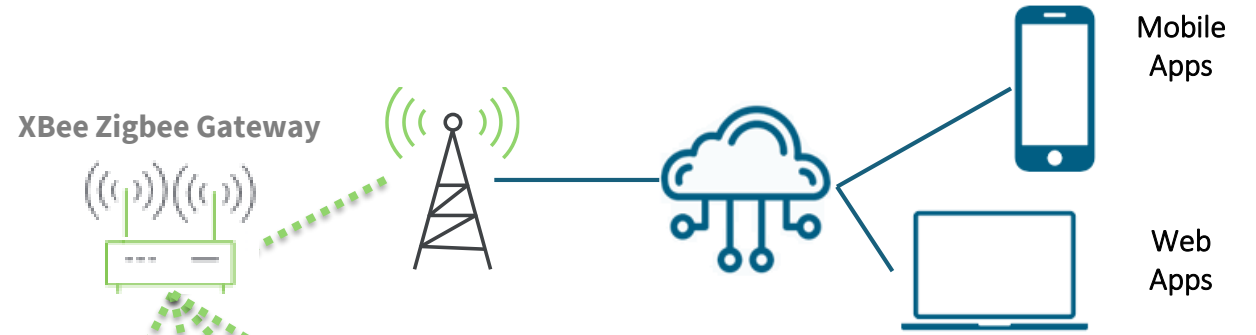
Utility-Scale Solar Networks

- Solar trackers – track sun across sky
- Majority are single-axis
- Shadow elimination is paramount
- Algorithms must be dynamic



Utility-Scale Solar Networks

- Solar panels connected through Digi XBee – Zigbee mesh
- Angle control
- Energy data, status, etc.



Residential Solar Energy

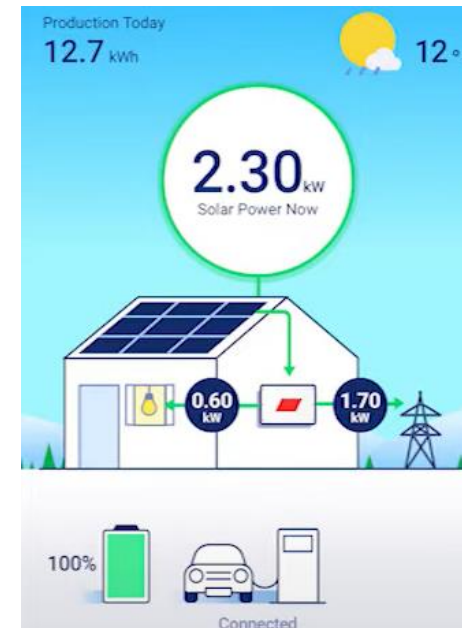


<https://www.cleanenergyreviews.info/blog/hybrid-solar-selection-guide>

IoT Benefits in Solar-Driven Home Energy

- Safety: Disconnect from grid during power outage (law)
- Control and functionality:
 - Configure settings
 - Contact support
 - Get alerts about system issues
 - Load control
- Information and Monitoring
 - System health
 - Energy source: Grid, panels or batteries.
 - Where did excess energy go?
 - Energy stored in batteries.
 - Energy provided by solar panels.
- Value to solar provider
 - ROI Data!

29.3 KWh 1.1.1	28.5 KWh 2.1.1	28.1 KWh 2.1.2	29.68 KWh 2.1.3	29.21 KWh 2.1.4	29.15 KWh 2.1.5	28.57 KWh 2.1.6
29.63 KWh 1.1.2	29.72 KWh 1.1.3	28.92 KWh 2.1.7	29.04 KWh 2.1.8	29.48 KWh 2.1.9	29.63 KWh 2.1.10	29.34 KWh 2.1.11
29.55 KWh 1.1.4	28.9 KWh 1.1.5	28.33 KWh 1.1.6			29.23 KWh 2.1.12	
29.6 KWh 1.1.7	28.8 KWh 1.1.8	25.43 KWh 1.1.9			28.97 KWh 2.1.13	
29.95 KWh 1.1.10	28.53 KWh 1.1.11	22.38 KWh 1.1.12			29.3 KWh 2.1.14	
29.96 KWh	29.52 KWh	29.21 KWh			28.88 KWh	



EV Charging

- Growing market
- Government-backed growth
- IoT benefits for both residential and commercial



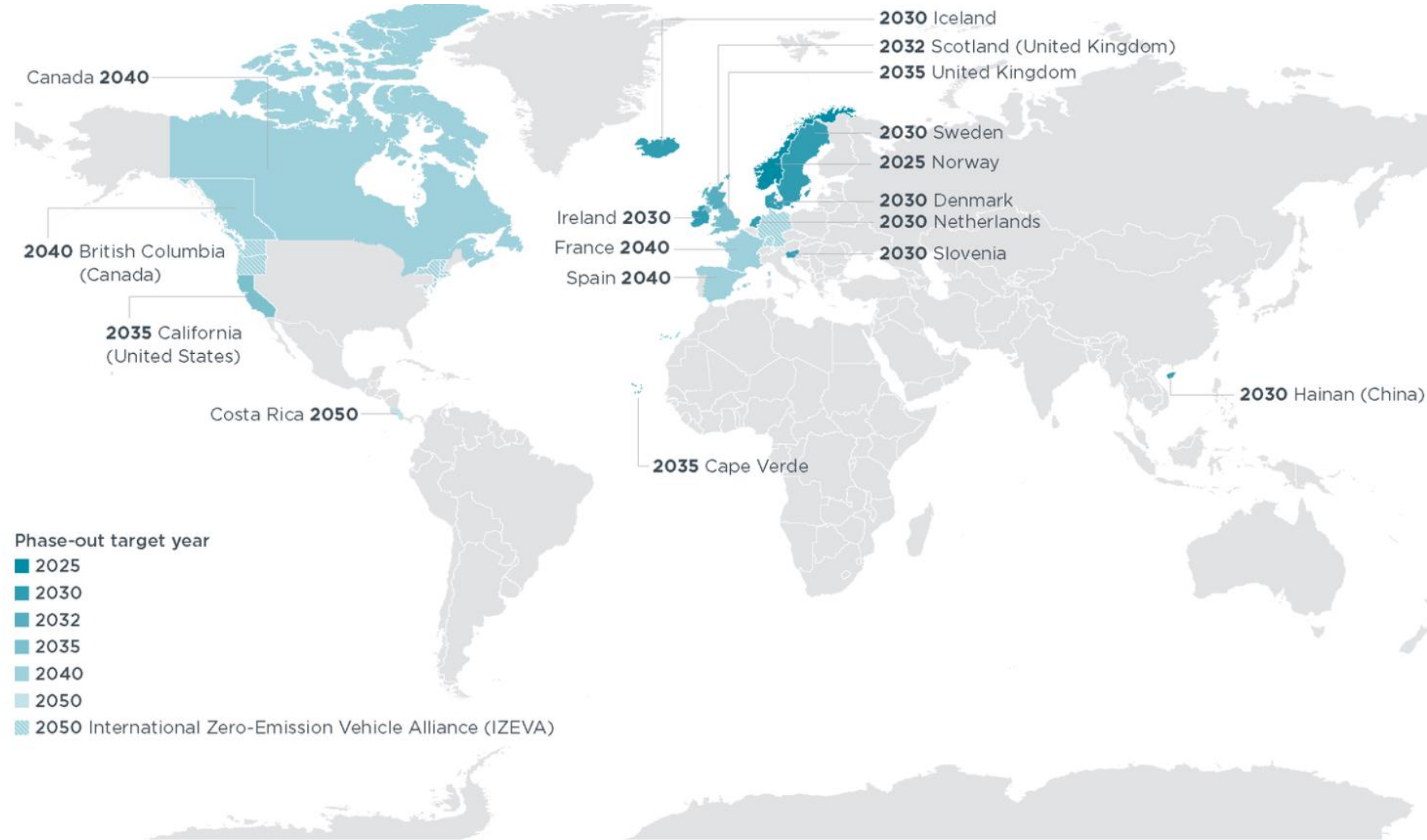
EVSE Market

Attractive Opportunities in the Electric Vehicle Charging Stations Market



<https://www.marketsandmarkets.com/Market-Reports/electric-vehicle-supply-equipment-market-89574213.html>

Government Phase out of Gas-Powered Vehicles



Source: ICCT

EV News

- **Tesla** tops Toyota to become largest automaker by market value (July 2020)
- **VW** - Investments in battery-powered vehicles, autonomous driving and related future technologies will rise to about 73 billion euros (\$86 billion), or half the company's 150-billion euro budget through 2025, [VW said in a statement](#). That's up from 60 billion euros (\$71 billion) a year ago, or 40 percent of investments planned at the time. (Nov 2020)
- **Audi abandons combustion engine development** (Mar 2021)
- **VW brand to halt combustion engine development** Following Audi's lead, the Volkswagen brand VW no longer intends to develop new combustion engines. (Mar 2021)
- **GM** plans to spend \$27 billion on all-electric and autonomous vehicles through 2025, an increase of \$7 billion, or 35%, from initial plans announced in March. The increased investment will support GM's plans to release 30 new EVs globally by 2025. (Nov 2020)
- **Ford** - Ford says it will go all-electric in Europe by 2030 (Feb 2021)

Types of EV Charging

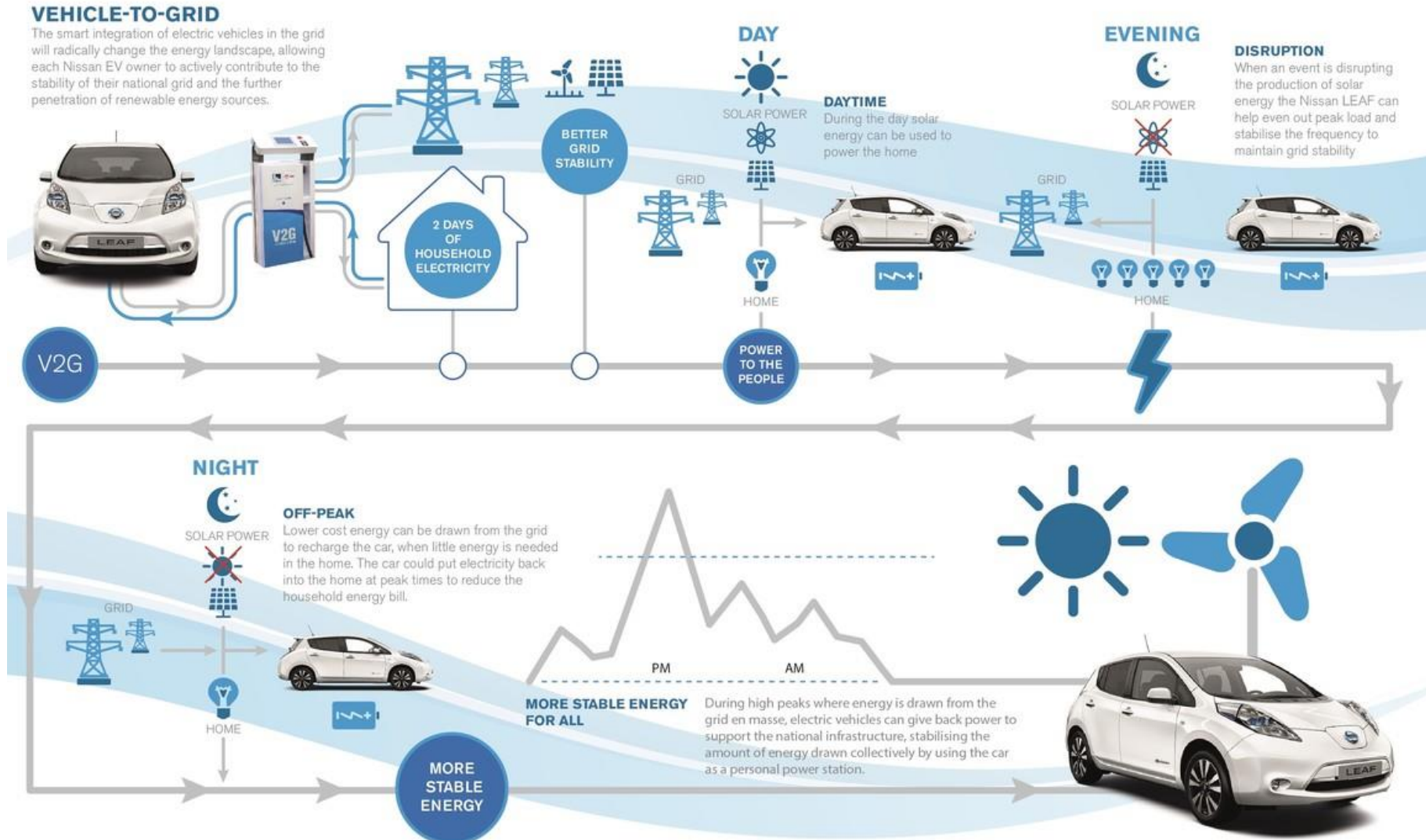
	Level 1	Level 2	DC Charging
Type and Description	<ul style="list-style-type: none">• 120 Volt AC• Uses standard wall outlet• Cord that comes with the EV	<ul style="list-style-type: none">• 240 VAC• Requires installation of an EVSE unit and electrical wiring capable of handling higher voltage• Eligible for utility demand response programs	<ul style="list-style-type: none">• DC• 80% charge in 30-60 minutes• Converts high voltage AC to DC for direct storage in EV batteries• Most common in public stations
Charge Time	6-8 hours	3-4 hours	30 minutes
Advantages	<ul style="list-style-type: none">• No installation cost• Low impact on electric utility peak demand	<ul style="list-style-type: none">• Faster charge time• More energy efficient than Level 1• Can participate in advanced utility programs	Fastest charge time
Disadvantages	Slow charging	<ul style="list-style-type: none">• More expensive than Level 1• Higher impact on peak demand charges	<ul style="list-style-type: none">• Significant equipment and installation cost• High peak demand charges

EV Charging Networks

- Connected networks of chargers
- Retail stores, rest stops, business parking garages, commercial parking owners, etc.
- Level 2 or DC
- Pay-to-charge
- Chargepoint, Electrify America, etc.
- IoT makes possible:
 - Payment collection
 - Charge monitoring and control
 - Usage
 - Availability



Vehicle to Grid (V2G)

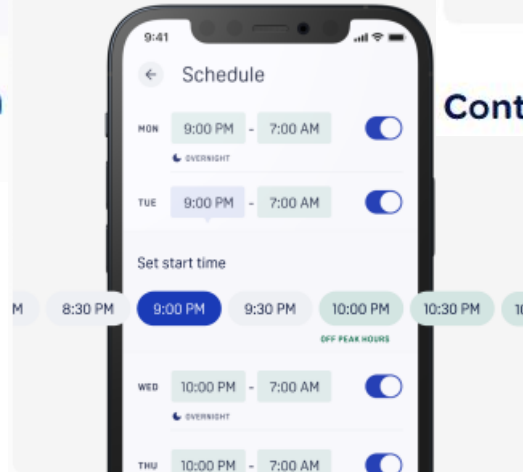


<https://www.linkedin.com/pulse/vehicle-grid-technology-ali-bahrami/>

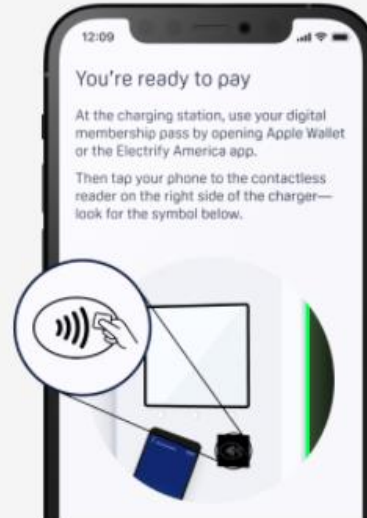
IoT Benefits



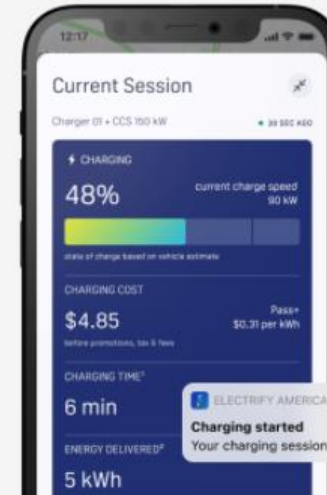
Manage your session remotely



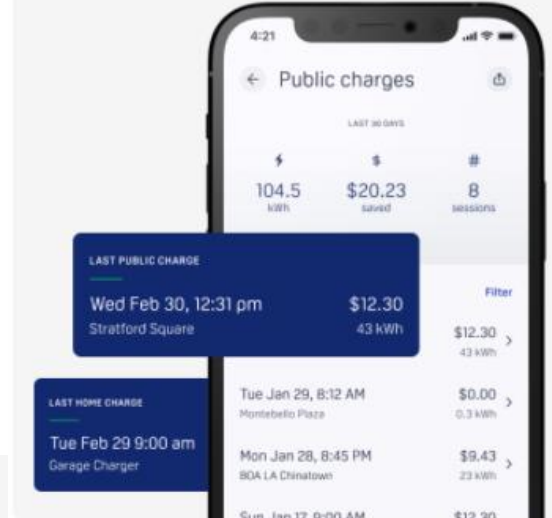
Schedule preferred charging times



Contactless payment



Track your progress



See your charge history

- Availability Alerts
- Load Balancing
- V2G
- Premium offers in app
- Find stations
- Payment

Digi XBee

The most complete offering of easy-to-use radio modules for IoT applications



Silicon Labs EFR32 Wireless Gecko



▪ Low Power

- Scale power consumption by taking advantage of multiple energy modes including a 0.9 μ A Deep Sleep mode, with 16 kB RAM retention and operating real-time clock. Respond quickly to real-world events with ultra-fast wake-up times and the Deep Sleep mode capability to perform analog measurements, bypass the CPU with peripheral to peripheral connections, and detect RF signals.



▪ Feature Rich

- Take advantage of a rich selection of integrated high performance and low power peripherals including ADCs, DACs, timers, capacitive touch, and communication options spanning I²C, USB and Ethernet. Reduce design complexity and bill of materials (BOM) with on board radios featuring integrated baluns, crystal-less 500 ppm sleep timers, and multiprotocol support.



▪ Security Enabled Hardware and Software

- Make use of hardware security technology including a secure bootloader, energy-efficient cryptographic accelerators for AES, ECC, and SHA, a true random number generator (TRNG), and a security management unit (SMU) for software-based fine-grained control over peripheral access.

▪ Multiprotocol Connectivity



Bluetooth Mesh



Bluetooth LE



Proprietary



Thread



Wi-Fi



Wi-SUN



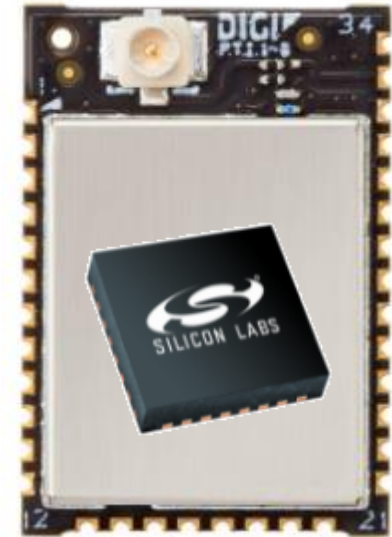
Zigbee



Z-Wave

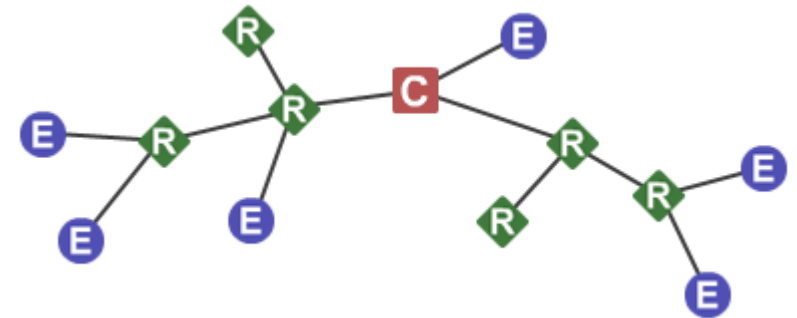
XBee 3 Features

- Zigbee protocol
- Bluetooth protocol for
 - ▶ Device provisioning/configuration
 - ▶ Bluetooth sensors
 - ▶ Bluetooth beaconing
- Micropython programming for edge processing
 - ▶ Predictive maintenance
 - ▶ Device control
 - ▶ Alerts on device conditions
- Digi TrustFence Security



Zigbee Overview

- Operates on 802.15.4 PHY, usually at 2.4GHz
- Multiple network topologies – point-to-point, point-to-multipoint, and mesh
- Low duty cycle – long battery life
- Low latency
- Up to 65,000 nodes per network
- 128-bit AES encryption
- Collision avoidance, retries, and acknowledgements
- OTA upgrade capability
- Not an IP-based protocol



C = Coordinator

R= Router

E = End Device

Thank you

KYLE SPORRE | 15 SEPTEMBER 2021



Additional Sources

- <https://www.cleanenergyreviews.info/blog/hybrid-solar-selection-guide>
- <https://www.youtube.com/watch?v=od5yWB5aE0c>
- <https://www.verogy.com/get-solar-farm-land/>
- <https://www.virta.global/vehicle-to-grid-v2g>
- <https://www.solarpowerworldonline.com/2020/05/standard-solar-develops-solar-tracker-system-on-maryland-farm/>
- <https://www.digi.com/solutions/by-technology/zigbee-wireless-standard>