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Colorado's NREL researching ways AI can help reduce greenhouse gas emissions

By Dan Larson | 23 hours ago

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SUMMARY: The National Renewable Energy Laboratory is leading research on ways to decrease vehicle, residential and commercial impacts by taking a deep look at autonomous local networks.

Where does your coffee pot get its power? In the near future, a bit of code powered by Artificial Intelligence (AI) could make the decision.

Colorado is racing to reach a carbon-free landscape and researchers say that transitioning to all-electric power in homes and buildings will provide the biggest return in lowering carbon-dioxide emissions.

Golden-based National Renewable Energy Laboratory (NREL) researchers are investigating the possibilities of autonomous local networks. The hope is that one day, these networks can autonomously switch between microgrids and make adjustments to power distribution.

> **What are autonomous local networks?**
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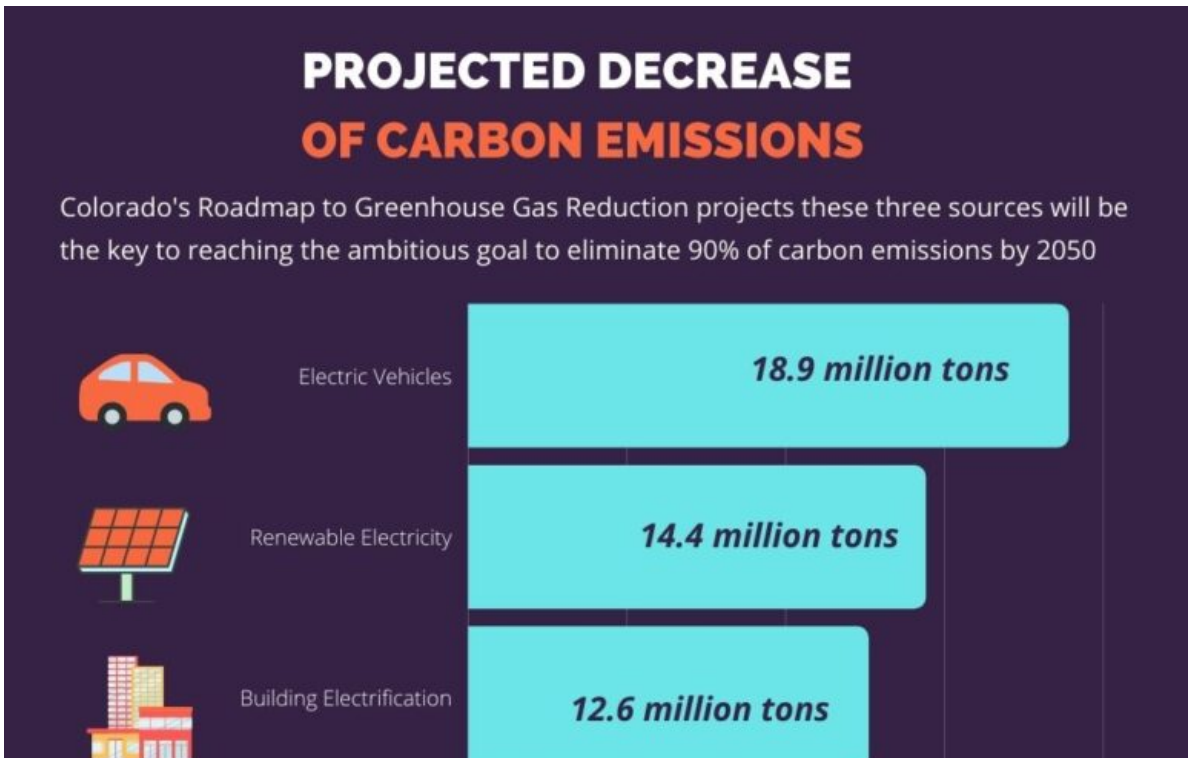
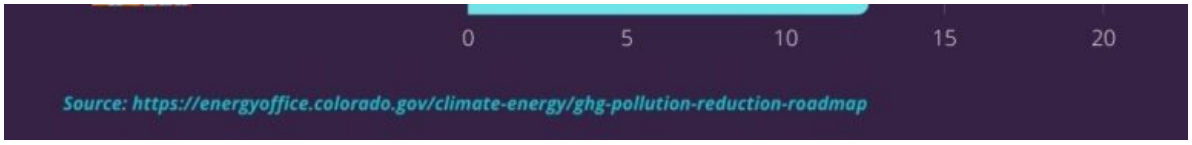
> *A system that can make decisions on when to switch between various microgrid and local networks that are connected to the central grid (for instance, solar or wind energy) based on supply, demand, power storage and economics. The innovation is getting the system to make these decisions autonomously through algorithms and Artificial Intelligence.*

In January, the latest version of the state's Roadmap to Greenhouse Gas Reductions was released. That came nearly two years after the Colorado legislature passed HB19-1261, its ambitious plan to eliminate 90% of carbon emissions in less than 30 years.

So far, the state's more than half-decade effort to chart a course toward reduced greenhouse gas (GHG) emissions has resulted in pledges from nearly all Colorado's regulated utilities to shutter coal-fired generating plants. The goal would be to replace their output with renewable assets like wind and solar.





Other policies are aimed at replacing gas-powered vehicles with electrics, reducing commuting miles driven, tightening methane emissions from oil and gas operations, agriculture and landfills, incentivizing use of electric heat pumps for homes, and increased monitoring and auditing of commercial and industrial emissions. The goals are aspirational.

"These commitments will reduce GHG pollution by more than 32 million tons by 2030," or 80% from a 2005 baseline, the roadmap predicts. Continuing to follow its path, Colorado can realize 90% lower CO_2 emissions by the mid-century mark, it states.

The largest wedges in tomorrow's carbon-reduction pie are today the largest sources of CO_2 in the state: transportation and power generation.

In its long-distance view, the roadmap plots a course toward a predominance of electric vehicles that, by 2050, will amount to a CO_2 reduction of 18.9 million tons. The increased renewable electricity generation will account for 14.4 million tons less CO_2 emitted, both representing significant slices of the pie. However, the fastest growing slice will come from electrification of residential and industrial buildings, from a modest 1.5 million tons less in 2025 to 12.6 million tons by 2050.

Next phase for Reorg

In late December, NREL was named to lead key parts of a federally funded research program into utility-scale grid integration

of solar and to further develop microgrid controls, including application of artificial intelligence, to improve resiliency and grid efficiency at the community level.

The new funding will build on NREL's existing research into autonomous energy grids, called Reorg: Resilience and Stability Oriented Cellular Grid Formation and Optimization for Communities with Solar PVs and Mobile Energy Storages (battery-powered vehicles).

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> *Santosh Veda, research manager for grid automation systems at NREL*

The lab says this next phase will see application of newly developed control technology that can independently manage a variety of local energy generators and storage devices, from rooftop solar and community solar gardens to electric school buses and residential power walls.

"We see the trend moving toward autonomous management of microgrids that can provide transactive controls similar to how a blockchain operates," says Santosh Veda, research manager for grid automation systems at NREL.

"It is an evolutionary process," he says. "For the past few years, we have seen advancements in distributed energy resource management systems (DER) that continuously balance the grid and improve economics for customers."

The difference between a microgrid and a DER system is that a

distributed system does not necessarily include the ability to isolate itself from the central grid, he says. Both types of small-scale power grids are networks capable of attributing power flow based on supply, demand, power storage and economics. The ability to make those decisions autonomously is the next step.

"Our research includes the algorithms that enhance flexibility behind the meter and consider all the distributed assets, whether generation or storage," Veda adds.

As electric power used by residential and commercial buildings grows, smart management will play a key role. The cost of solar power will continue to decline, Veda says, while energy storage options grow. It makes sense to use cheaper utility power during most times and local generation for pre-heating or pre-cooling and battery storage with power walls and electric vehicles.

By definition, microgrids must still have the ability to support a critical load if central grid power is interrupted, but most of the time microgrids will operate as another node on a distributed energy network.

All-electric communities

Key to the greater cuts in CO_2 emissions from buildings, despite a growing population, is forecast to come from all-electric communities that deploy networked, autonomous controls to balance local demand with power generation and storage and are driven by grid capacity and economics.

In the meantime, the roadmap recommends operators of existing large commercial and industrial structures be asked "to track energy use and make progress toward energy and pollution

performance standards.” Going forward, standards are to be developed for all new buildings that aim at reducing carbon emissions from gas-fired appliances by replacing them with electric heating and cooling. Driving this transition, “regulated electric utilities are to create programs that support beneficial electrification.”

> **What is beneficial electrification?**
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> *Beneficial electrification describes a largely voluntary replacement of oil and gas-powered vehicles, appliances, industrial processes and comfort heating/cooling systems with those powered by electricity generated without carbon emissions.*

About the author: Dan Larson is a Colorado-based writer and editor. He transitioned from newspapers and trade magazines to in-house publications, marketing communications and public affairs at Amoco, BP and Enerplus. In 2013, he launched a private consultancy specializing in writing, editing and public relations. Empowering Colorado strives for transparency and employs freelance journalists with knowledge and experience in energy issues. Empowering Colorado does not employ journalists who work full or part-time for energy companies.