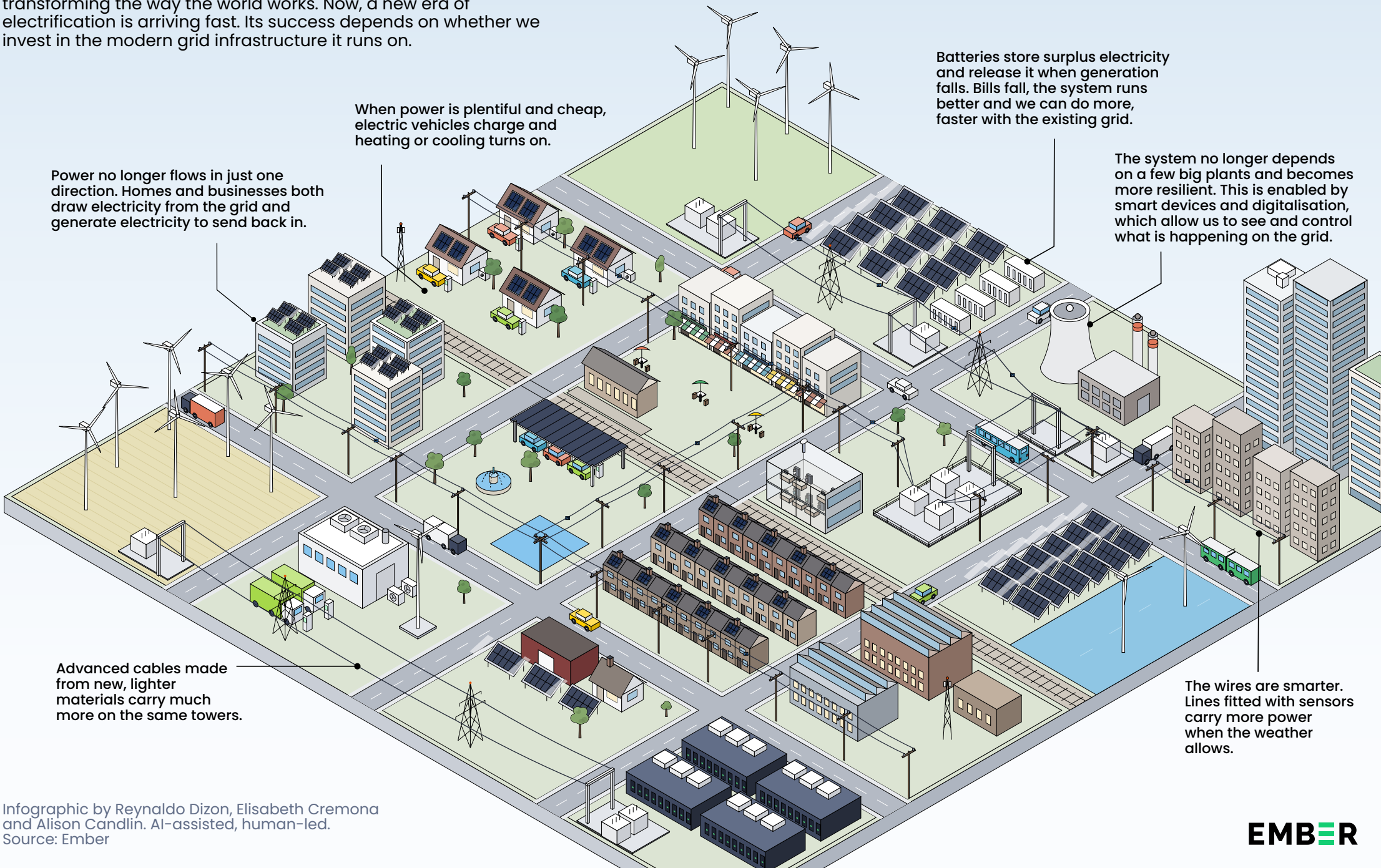
Building a grid for the age of power

Every age is remembered by what it built, with new infrastructure transforming the way the world works. Now, a new era of electrification is arriving fast. Its success depends on whether we invest in the modern grid infrastructure it runs on.



Infographic by Reynaldo Dizon, Elisabeth Cremona and Alison Candlin. AI-assisted, human-led.
Source: Ember

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Modernising the grid

The age of power is arriving fast, driven by the electrotech and information revolution. Its success depends on whether we invest in the modern grid infrastructure it runs on. Grid modernisation rests of three pillars: optimisation, reinforcement and expansion.

Optimise Get more out of the grid that already exists

Reinforce Strengthen and upgrade the existing grid

Expand Build new lines and substations where needed for new generation and demand

	Low cost	Medium cost		High cost
Fast	**Carry more power on existing lines** Dynamic line ratings (DLR), weather-linked line monitoring, dynamic transformer ratings, intertrip and remedial action schemes			
	Steer power around bottlenecks Advanced power-flow control devices, topology optimisation software			
Medium	**Track grid status for predictive maintenance** Condition monitoring sensors, analytics for transformers and lines, predictive maintenance software	**Use batteries to turn wind and solar into baseload power** Battery energy storage systems, at grid and distribution scale	**Turn baseload plants flexible** Flexibility retrofits, including faster ramping controls and reduced minimum-load operation	**Build substations for new demand or supply** New substations, transformers, switchgear
	Improve forecast of supply and demand AI and machine learning forecasting, weather-based renewable forecasting, demand forecasting	**Live data for better grid operations** Smart meters and sensors, supervisory control and data acquisition (SCADA), advanced distribution management systems	**Upgrade wires to carry more on existing routes** Advanced conductors, high temperature super conductors	
	Turn homes and businesses into flexible capacity with demand response Demand response, virtual power plants, energy management systems, managed EV charging, bidirectional chargers for vehicle-to-grid, remote activation of electric hot water systems	**The right technologies keep the grid stable without spinning generators** Synchronous condensers, static VAR compensators, static synchronous compensators (STATCOMs), grid-forming inverters, including grid-forming batteries	**Restore power fast and keep the lights on locally** Automated fault location, isolation and service restoration (FLISR), automated reclosers and switches, feeder automation, intentional islanding, microgrid controllers	
	Let households export more solar to local networks, safely Dynamic operating envelopes, flexible export limits, active network management software, dynamic export-capable inverters, distribution network monitoring and forecasting	**Increase cybersecurity in step with digitalisation** Access controls and network segmentation for control systems (SCADA, energy management and distribution management systems), protected communication links, security requirements in procurement		
Slow		**Upgrade existing substations** Higher-capacity transformers and switchgear, digital substation equipment (sensors, protection and control)		**Wires reach new places** New overhead transmission lines, new underground or subsea cables, new corridors
				Direct current moves power across long distances and borders HVDC links using voltage source converters, converter stations, new interconnectors, using alternating or direct current

Cost and time ratings in this table are comparative and indicative. No rating refers to a specific cost or date. Costs and timelines differ in every country, but the relative order is a useful guide to show which interventions can move fastest, which likely take the longest and which tend to cost more or less.

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