

The cooling challenge

Ways to break the vicious cycle of cooling

Reducing cooling and energy demand by passive cooling and high energy efficiency:

- **Buildings:** Effective solar shading, internal load reduction, airtight- and low-heat-transmission building shell, controlled ventilation
- **Systems:** Efficient components, adequate (demand) control systems, efficient distribution systems (water better than air), maintenance

Buildings



Solar shading



Load reduction



Controlled ventilation

Systems



Demand control



Maintenance

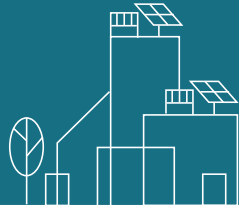


Efficient components

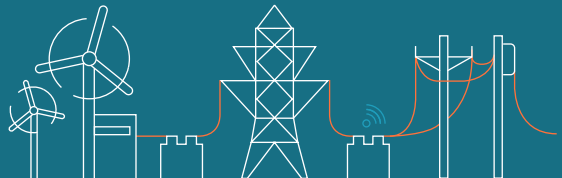
Reducing indirect emissions by renewable energy supply:

- **On-site:** Solar photovoltaic, solar thermal, storage for load shifting (thermal and/or batteries)
- **Off-site:** Same as on-site options plus wind energy

On-site



Off-site



Reducing direct emissions by sustainable cooling solutions:

- **Compression systems with natural refrigerants:** e.g. Propane (R290) split units, transcritical CO₂ (R744) supermarket refrigeration, central chillers with ammonia (R717), propane, CO₂ or water (R718), isobutane (R600a) or propane stand-alone refrigerators and freezers
- **Deep water source cooling** using a large body of naturally cold water as a heat sink (e.g., deep areas within lakes, oceans, aquifers, or rivers)
- **Thermal sorption chillers**
- **Not-in-kind technologies:** e.g., electrocaloric, elastocaloric, magnetocaloric or thermoelectric

Natural refrigerant systems



Deep water source cooling



Thermal sorption chillers



Not-in-kind technologies



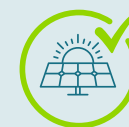
Sustainable cooling systems are characterised by:



Low emissions (indirect and direct)



No harmful & persistent degradation products



Increase of renewable energy supply