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## **RDH: Cooling required in multifamily buildings**

- $\rightarrow$  Install heat pumps, not traditional air conditioning.
- → Specify refrigerants with low Global Warming Potential (GWP).
- → Consider hydronic distribution in lieu of refrigerant distribution.



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## **RDH:** Passive cooling required in every building

- $\rightarrow$  Power-outs most likely to occur during heat waves.
- → Reduce glazing areas. Increase operable windows.
- Design operable exterior shading devices.
- → All-glass buildings could turn deadly if power-out occurs during extreme heat.



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## **RDH: Evaluate potential for overland flooding**

- → US & Canadian flood maps are out of date.
- ightarrow The "100-year-flood" concept is not valid.
- → Heavy rain means rivers & creeks can flood any time.
- → Will building function after a flood? Don't put essential equipment in basement!



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## **RDH: Filtered Energy Recovery Ventilation**

- → Filtered ventilation improves indoor air quality.
- → Energy-recovery ventilation significantly reduces cooling and heating loads.
- → Centralized systems cost less to install and maintain.
- → Central systems can provide dehumidification.



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 $\rightarrow$  Active cooling required in every residential building: Heat pumps.

- $\rightarrow$  Passive cooling required in every residential building: Operable exterior shades.
- $\rightarrow$  Passive House grade thermal enclosures create resilience during power outs.
- ightarrow Evaluate potential for overland flooding: Flood maps are out of date.
- $\rightarrow$  Calculate max sea level rise: 1 meter minimum, up to 10 meters with ice melt.
- $\rightarrow$  Move mechanical and electrical systems from basements to upper floors.
- $\rightarrow$  Filtered energy recovery ventilation needed in every residential building.

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## (No.) Because buildings also leak refrigerants

- ightarrow Fluorinated gases have no natural sources.
- $\rightarrow$  The most common refrigerant, HFC-410a, carries **2,088 times more Global Warming Potential** compared to CO<sub>2.</sub>
- → Two litres of leaked HFC-410a does as much climate damage as driving a car for a year.



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Typical passenger vehicle emits about 4.6 metric tons of carbon dioxide per year: U.S. EPA.







#### "Refrigerant leakage is one of the biggest contributors to climate change within the building industry."

"Refrigerant leakage occurs at the manufacturing stage, continuously in operation and at end of life when the product is decommissioned. Refrigerant must be topped up annually due to leakage."

"In 2016, the Kigali accord set an agenda to phase out these high GWP refrigerant gases, but the reality is that such refrigerants are still widely used."

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"Refrigerants & Environmental Impacts: A Best Practice Guide," Elementa Consulting (Integral Group) September 2020





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# RDH: Every building needs a plan to eliminate greenhouse gas emissions

- ightarrow Eliminate "Natural Gas" (methane) and other fossil fuels as soon as feasible.
- $\rightarrow$  Replace gas cooktops with induction. This also improves indoor air quality.
- $\rightarrow$  Install heat pumps for cooling/heating, and for hot water.
- ightarrow Reduce cooling & heat loads through shading & insulation.
- ightarrow Prioritize low-GWP refrigerants such as C02 (R744), Propane (R290), or similar.
- ightarrow Use mid-GWP refrigerants such as R32 sparingly.
- ightarrow Specify hydronic distribution (water), avoid Variable Refrigerant Flow (VRF).
- ightarrow Mitigate refrigerant leaks & require refrigerant recovery.

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## What the 2040s will look like, on our current path

- $\rightarrow$  Global heating surpasses 2°C. Possibly double where we are at now .
- $\rightarrow$  Heatwaves that used to occur once per 10 years will occur 6x every 10 years.
- ightarrow Droughts will happen more often and be about 2.4x as severe.
- ightarrow Sea-level rise will surpass 0.5 meters, possibly more if land ice melts faster.
- ightarrow Air quality will worsen, mortality from air pollution will rise.
- $\rightarrow$  Parts of the Middle East will too hot for human survival, leading to migration.

Note: Many of IPCC's previous predictions happened years ahead of schedule.

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Probabilities for SSP5 (RCP 8.5) scenarios extracted from AR6 reports.







## Washington State: No gas in new buildings

- → 2023: New commercial and multifamily buildings will no longer be allowed to use natural gas or other fossil fuels for space heating and some water heating.
- → Municipalities in California, New York, and Massachusetts pursuing similar paths.



Washington Governor Jay Inslee

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