ENOUGH

EUROPEAN FOOD CHAIN SUPPLY
TO REDUCE GHG EMISSIONS BY 2050

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Decarbonising the food chain, challenges and opportunities for the food industry

Road maps to decarbonise the European food chain

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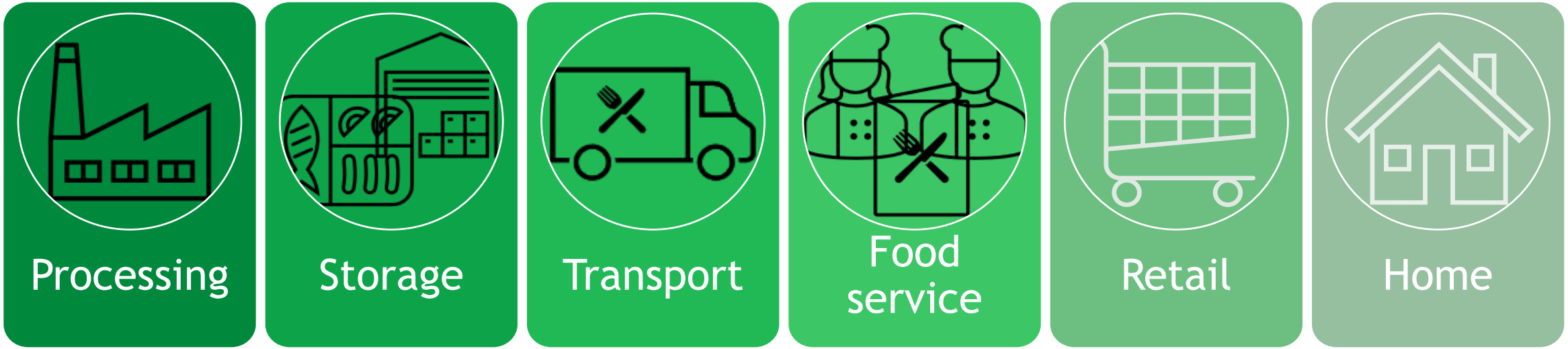
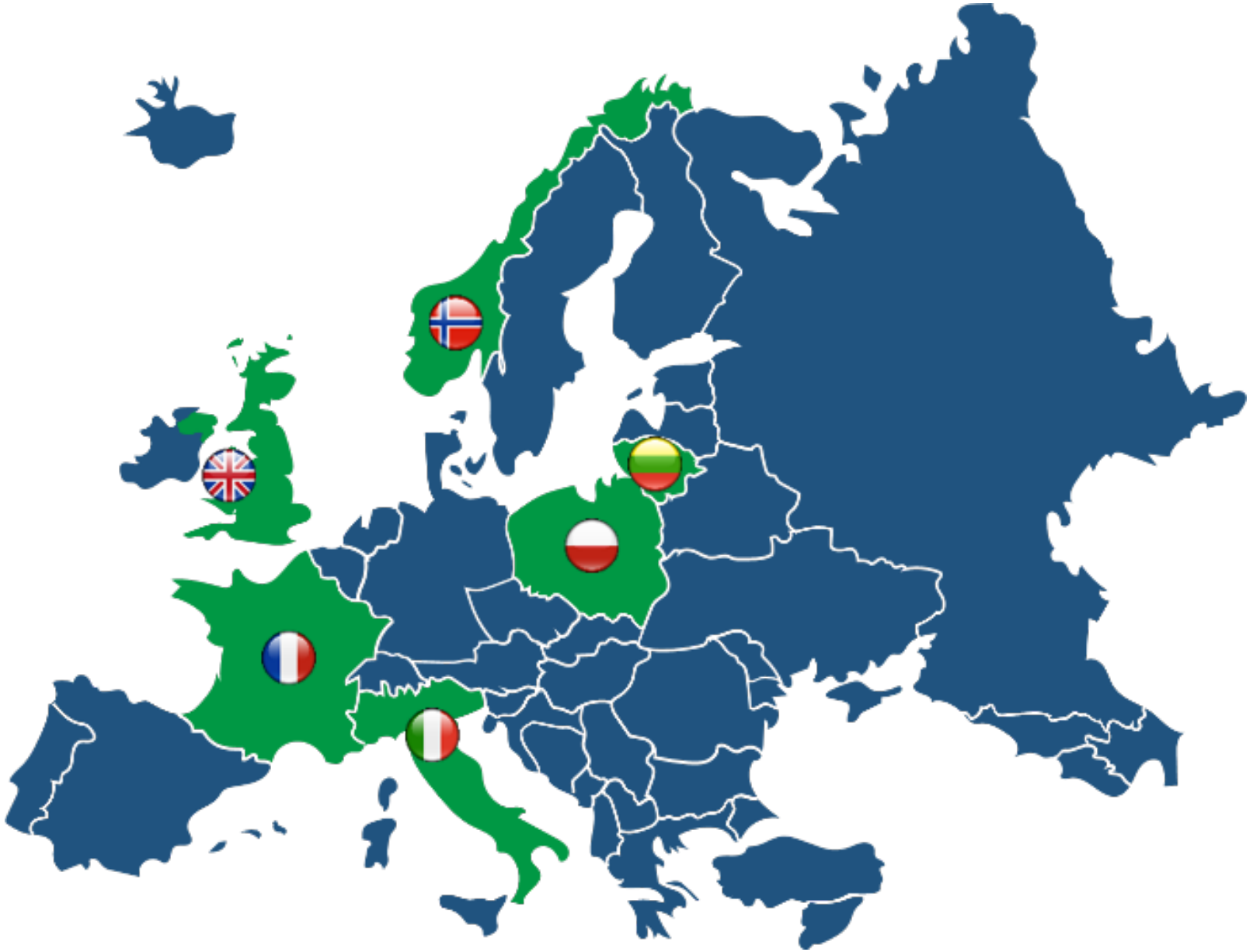
Aim

- Road maps for food industry sectors
- How to best decarbonise now and through to 2050
- 6 sectors



Road maps

- 6 countries:
  - France
  - Italy
  - Lithuania
  - Norway
  - Poland
  - UK



Road maps

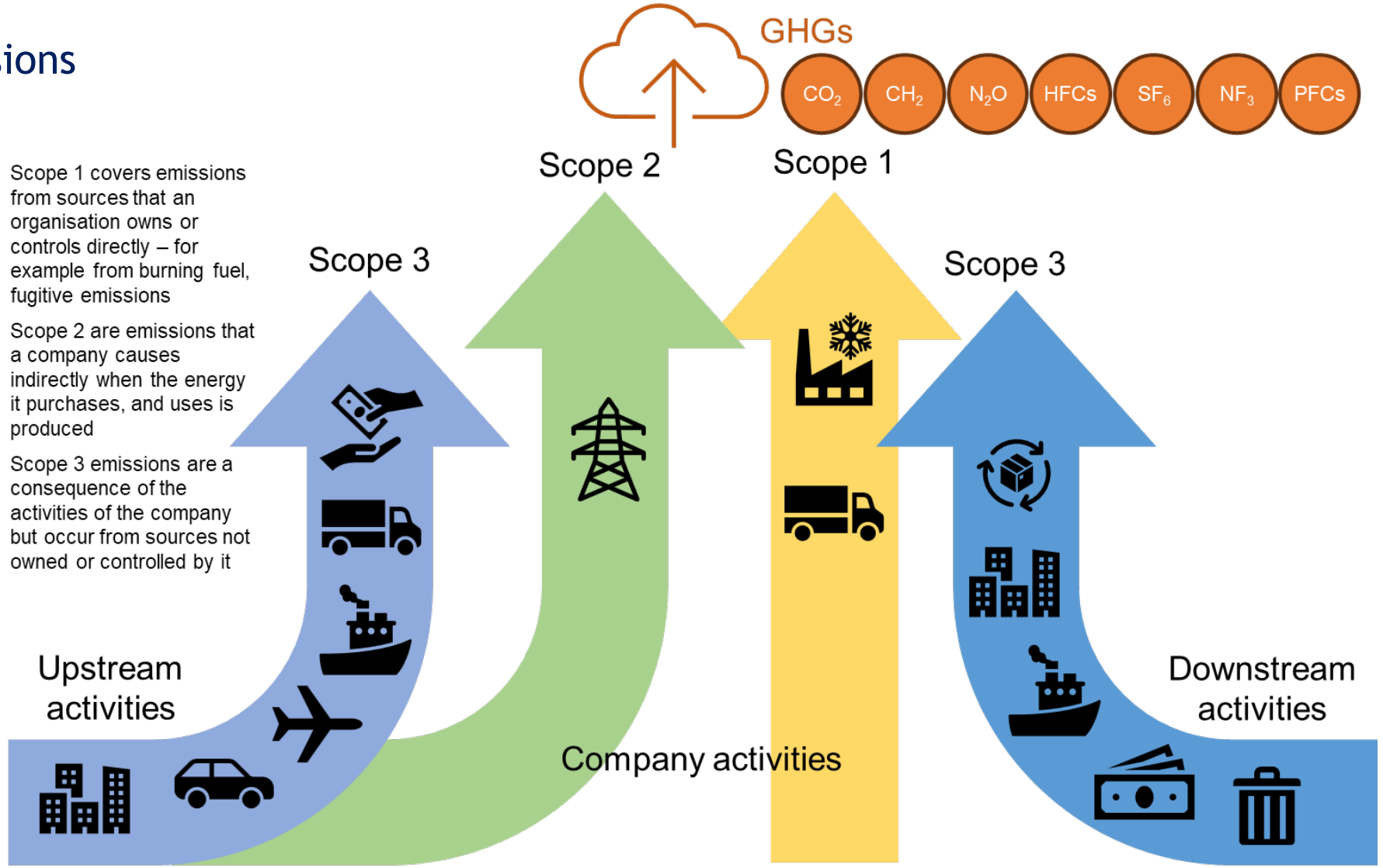
Scope 1 and 2 emissions

- Company facilities
- Company vehicles
- Purchased electricity, steam, heating and cooling
- Purchased goods and services
- Processing and use of sold products
- Leased assets
- Capital goods
- Transportation and distribution
- Business travel
- Employee commuting
- Investments
- End of life treatment of sold products

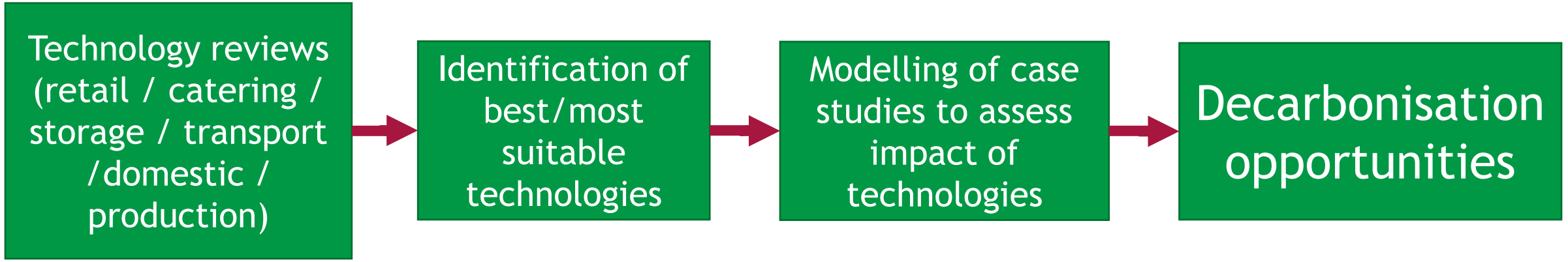
Scope 1 covers emissions from sources that an organisation owns or controls directly – for example from burning fuel, fugitive emissions

Scope 2 are emissions that a company causes indirectly when the energy it purchases, and uses is produced

Scope 3 emissions are a consequence of the activities of the company but occur from sources not owned or controlled by it



Road maps - process

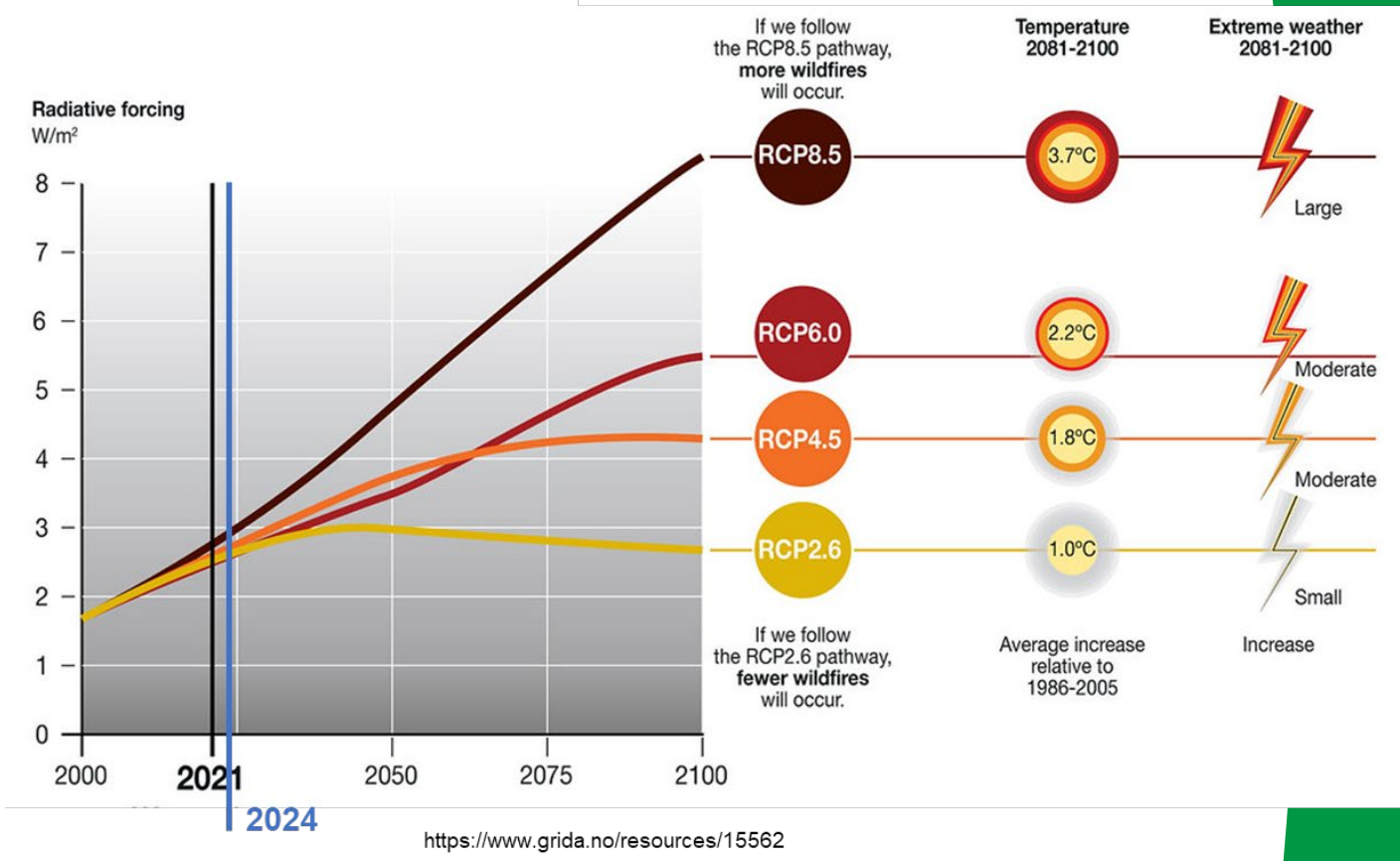


Processing: meat, dairy, fish, processed products

Post processing foods mixed

Method

- Models: EnergyPlus, bespoke models (ice-e, CNR transport model)
- Technologies (both technological and operational) to reduce carbon emissions across the whole food chain
- Process heating and cooling and HVAC
- Only assess options with high TRL
- Identify the reduction in energy and carbon emissions for each carbon reduction measure and assess the cost and time for application
- Assess over typical year
- Impact to 2050
- RCP4.5

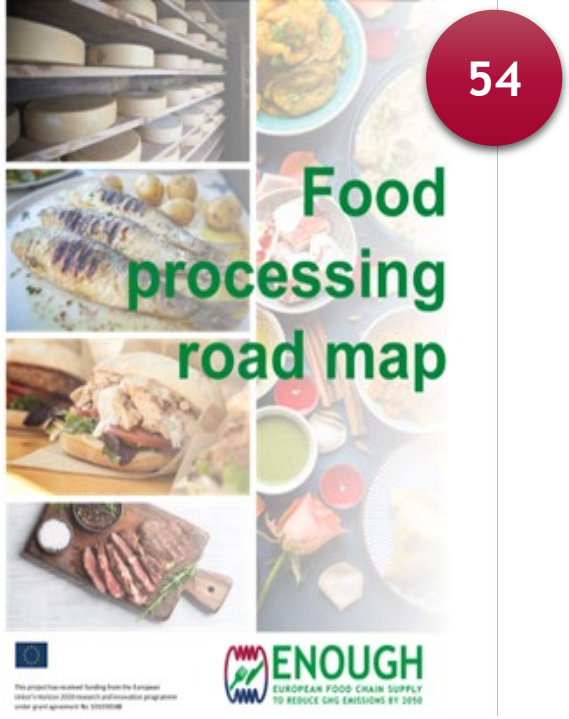


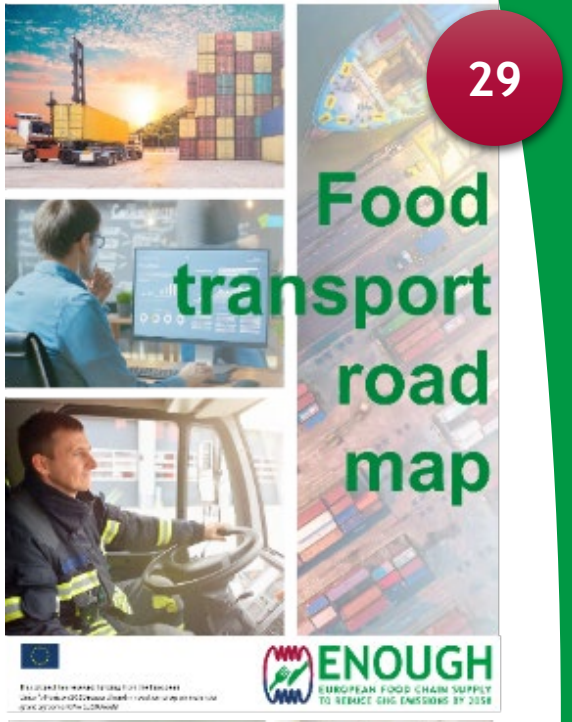
https://www.grida.no/resources/15562

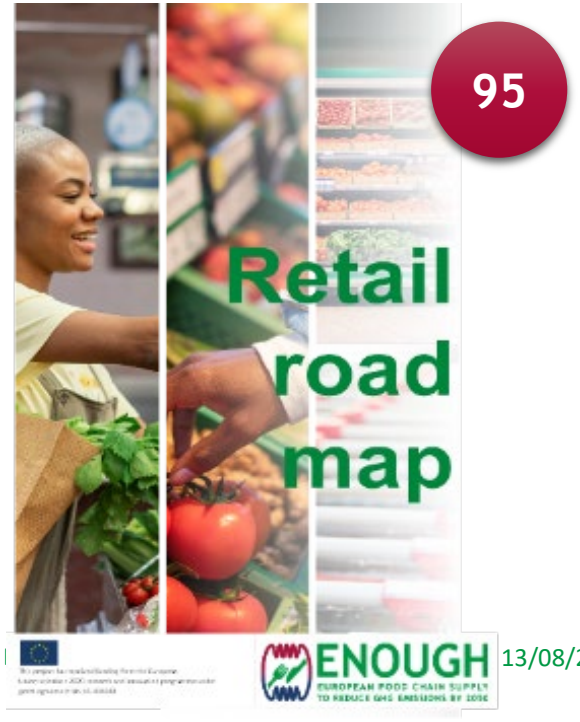
Representative Concentration Pathway(s) (RCPs) - trajectories of GHG concentrations

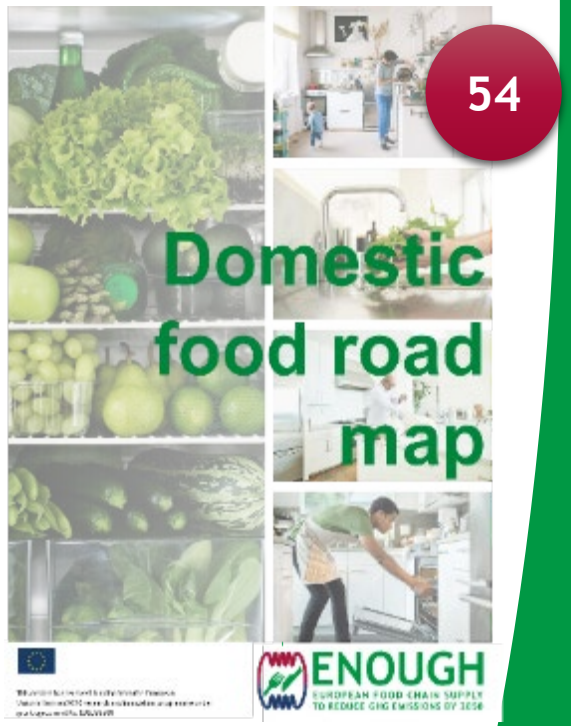
Used for climate modelling in the IPCC Fifth Assessment Report

Road maps









Number of technologies

Technologies/strategies (retail)

Display cabinets:

1. Adiabatic condensers
2. Aerofoil air-guide
3. Anti-fogging glass
4. Anti-sweat heater control
5. Boreholes and ground sink condensers
6. Cabinet lighting controls -dim/switch/occupancy sensors
7. Cabinet replacement with high efficiency version
8. Centralised air distribution
9. Defrost on demand
10. Defrost type
11. Distributed refrigeration system
12. Doors on cabinets
13. Dynamic demand
14. Economisers
15. Ejectors
16. Electronic expansion valves
17. Expanders
18. Fan motor outside of cabinet
19. Flooded evaporators (added to R744)
20. Heat from light outside cabinet
21. Heat pipes
22. Hydrophilic and hydrophobic coating on evaporators
23. Improved axial fans
24. Improved cabinet loading
25. Improved cabinet location
26. Improved glazing
27. Increased cabinet set point
28. Internet shopping
29. Lighting (cabinets) - efficiency
30. Lighting (store) - efficiency
31. Liquid pressure amplification (LPA)
32. Liquid-suction heat exchangers
33. Loading (food) – reducing heat load
34. Magnetic refrigeration
35. Motor Efficiency Controllers (MECs)
36. Nanoparticles in refrigerant
37. Night blinds and covers
38. Novel heat exchanger designs
39. Peltier cooling
40. Pipe insulation
41. Pipe pressure drops minimisation
42. Recommissioning
43. Reducing/floating head pressure
44. Reducing thermal radiation
45. Refrigerant - R744
46. Refrigerant - HFO refrigerants and blends
47. Refrigerant - HC refrigerants
48. Secondary systems
49. Shelf risers and weir plates
50. Short air curtains
51. Store dehumidification
52. Store temperature control (inc/dec set points)
53. Strip curtains
54. Suction pressure control
55. Tangential fans
56. Thermal store
57. Thermostatic flow control (TFC)
58. Training and maintenance
59. Trigeneration
60. Two stage compression
61. Vacuum insulated panels (VIP)
62. Variable Speed drives (VSDs)
63. Water loop systems

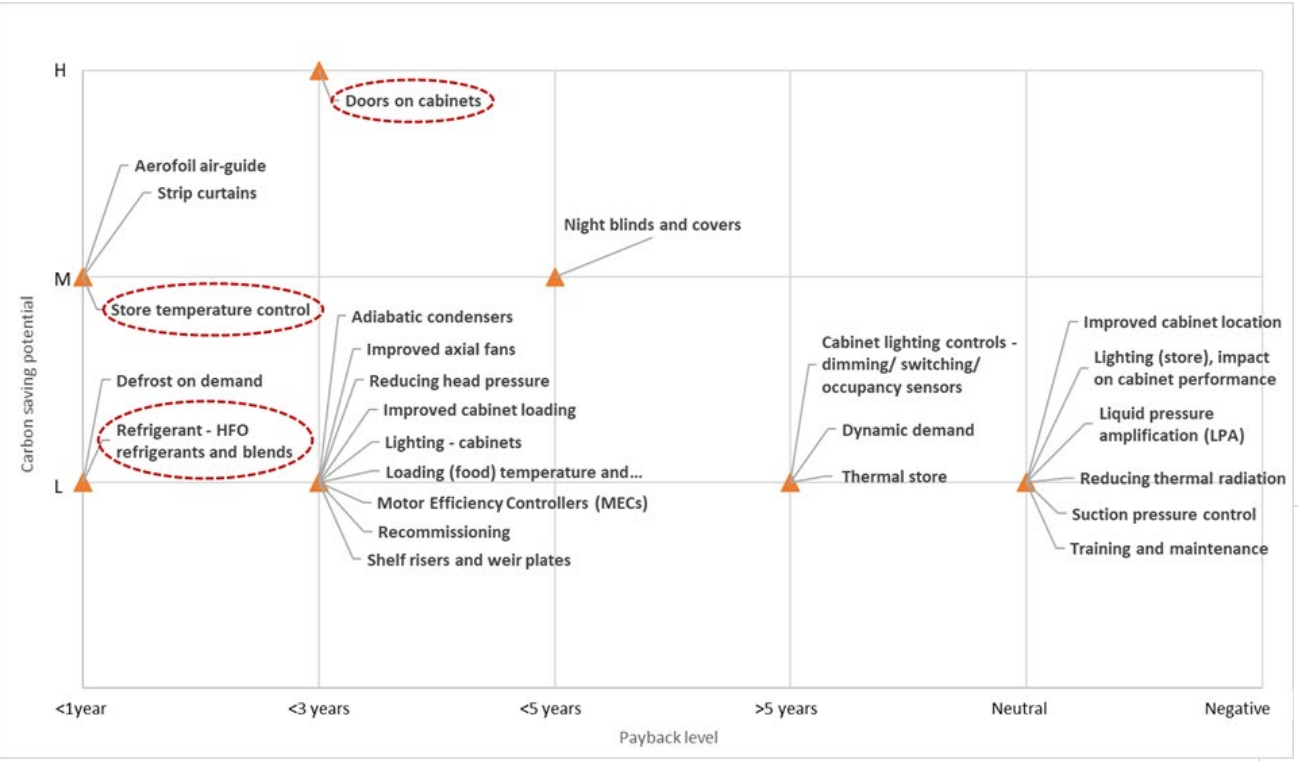
Ovens:

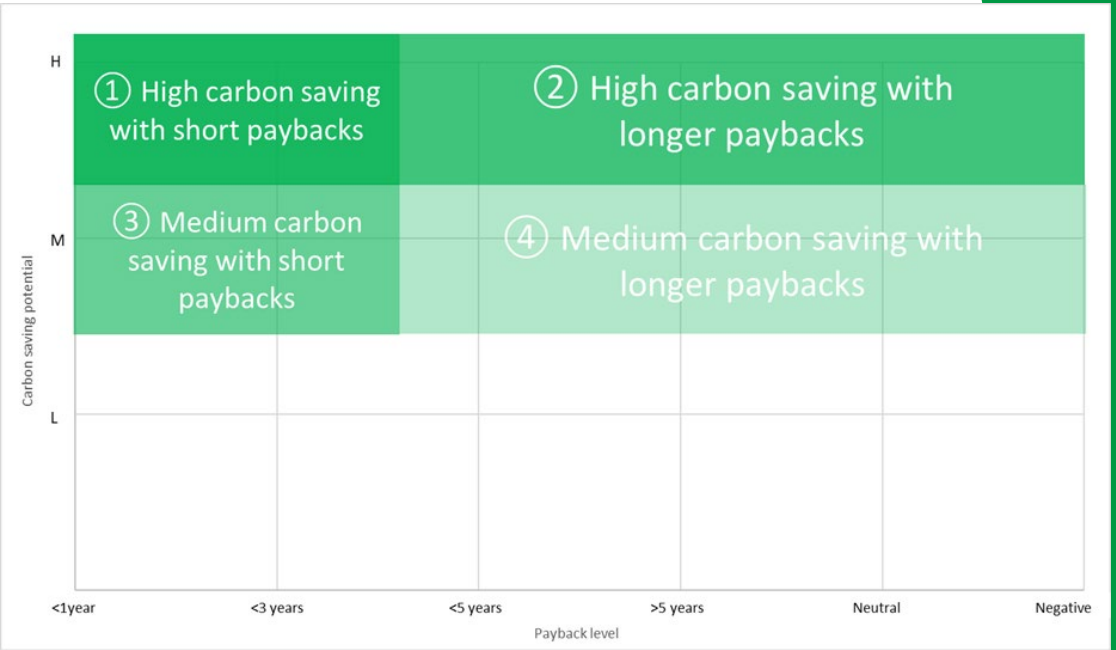
64. Air impingement
65. Automatic shutdown
66. Control of exhaust hood
67. Doors instead of open front/back
68. Efficient/improved oven design
69. Improved combustion efficiency (gas/oil)
70. Improved oven control e.g., active exhaust control
71. Keep oven loaded
72. Motor efficiency (mixers, conveyors etc.)
73. Position away from chillers/freezers
74. Recover exhaust heat
75. Reduce heating up time
76. Reduce thermal mass of tins
77. Switch off conveyors when not in use

HVAC:

78. Air conditioning
79. Cold air retrieval
80. Controls (advanced)
81. Boilers with higher efficiency
82. De-stratification fans
83. Door air curtain
84. Fan motors with higher efficiency
85. Heat pumps, heat reclaim and radiant heat
86. Natural/passive ventilation
87. Variable frequency drives
88. Other/ancillaries:
89. Building fabric optimisation
90. Building glazing optimisation
91. Building lighting efficiency
92. Renewable energy (solar electricity)
93. Renewable energy (solar thermal)
94. Packaging – low carbon options
95. Waste technologies

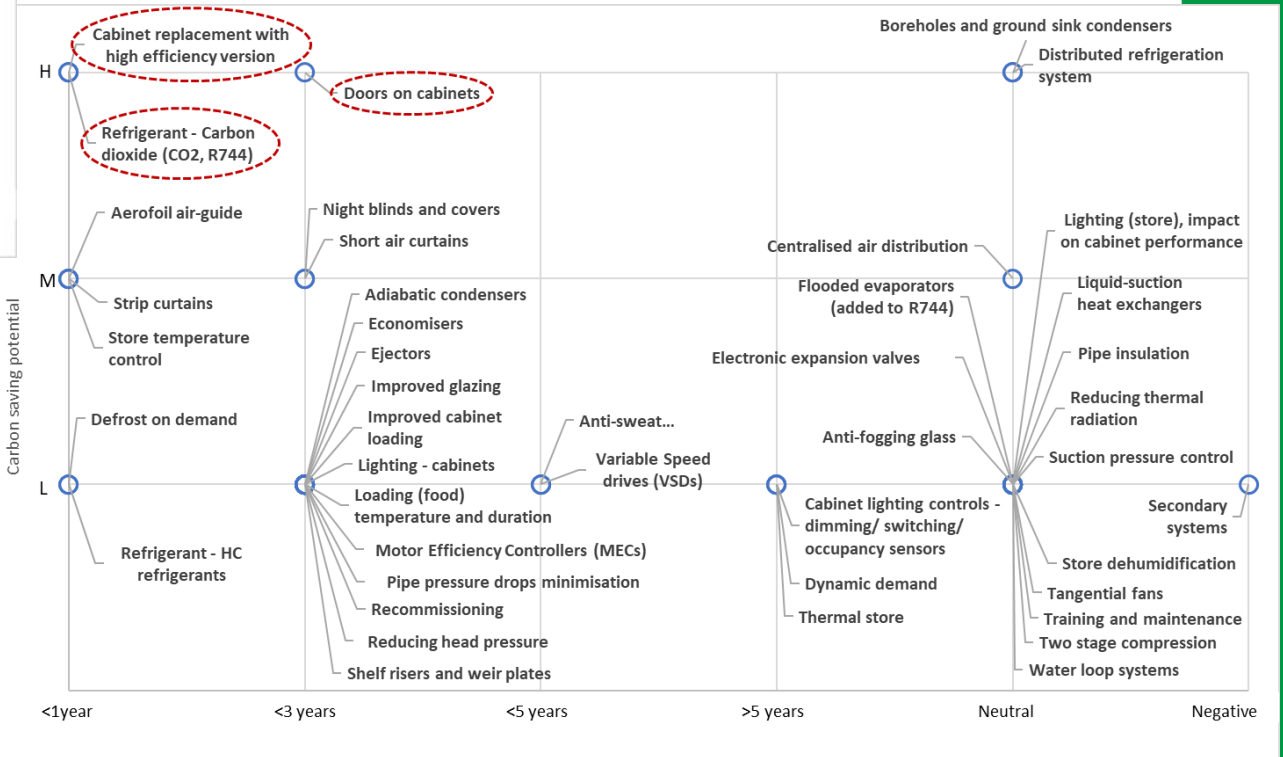
Selection of technologies/options





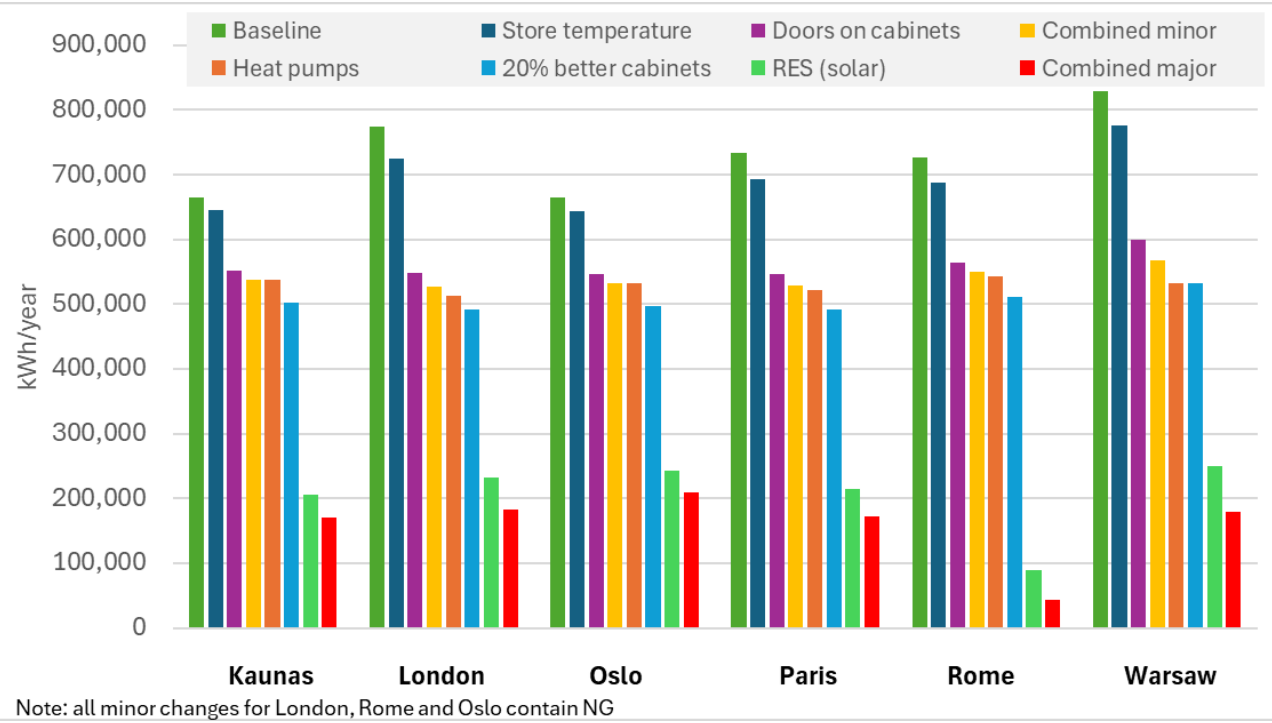
Refrigeration
Minor retrofit

Refrigeration
Major retrofit



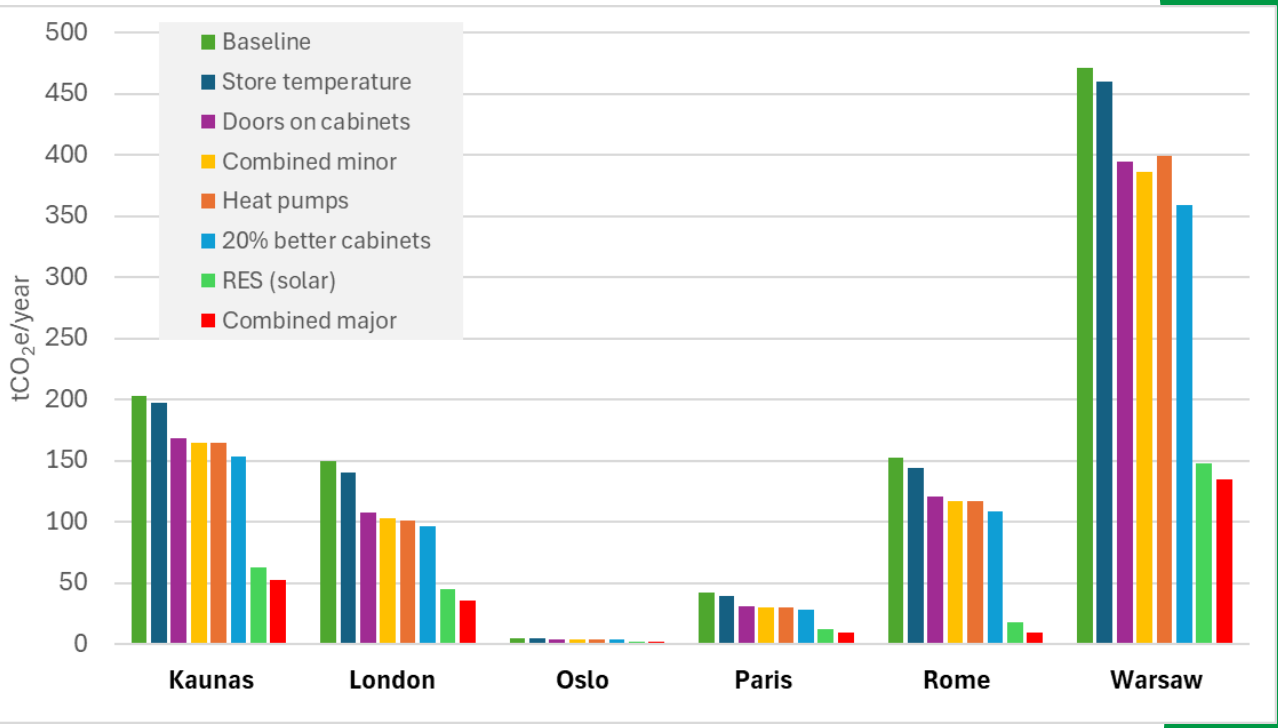
Results

2,100 m^2 store in 2020



Note: all minor changes for London, Rome and Oslo contain NG

ENERGY



CARBON

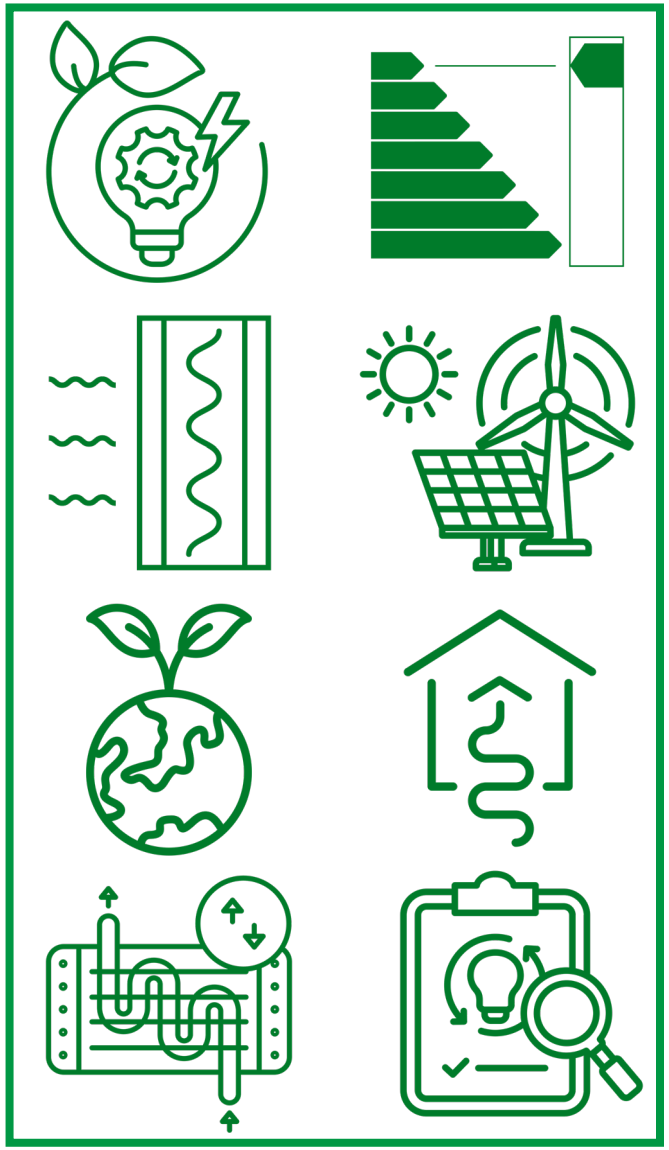
Road maps - retail

Technologies/ strategies	95
Model	EnergyPlus 2,100 m^2 (medium) and 600 m^2 (small) store
Scenarios	Minor retrofit: 1. Store dead band 2. HFO (small store only) 3. Doors on chilled cabinets 4. Combined minor retrofit Major retrofit: 1. Heat pumps 2. 20% better cabinets 3. RES (solar) 4. R744
GHG savings (now)	Minor retrofit (combined): Medium: 31% Small: 51% +Major retrofit (combined): Medium: 65% Small: 45%

Road maps – opportunities for carbon reduction

- Many options available:
  - Electrification (move from fossil fuels)
  - Purchasing efficient equipment
  - Minimising heat gains

    - e.g. infiltration, better insulation, operational efficiency, alternative practices/technologies
  - Use of RES
  - Moving to natural refrigerants
  - Use of heat pumps (low, plus high temperature)
  - Heat reclaim/exchange
  - Auditing, maintenance (+skills)



Conclusions

- Road maps:
  - Number of relatively simple and low-cost options available in all sectors examined
  - Options available to retrofit or for new systems
  - Possible to get very close to net zero in 2050 if apply best technologies but reliant on
    - Decarbonisation of grid electricity has major impact on reducing carbon emissions
    - Reduction in high GWP refrigerants
  - Electrification of systems is therefore an important part of decarbonisation
  - Early application of technologies/strategies enable less overall carbon emitted
  - Location has impact on selection of equipment and overall benefits

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 101036588

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THANK YOU!

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