Follow-up of radon-prone areas in Finland

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Radon risk area communication

www.radon.fi

- Municipal statistics and maps
- Post code area statistics
- 5x5 and 10x10 km grid maps based on 120,000 measured dwellings

- No official radon risk areas in Finland for dwellings

- Radon prevention in new building:
  Municipal authorities decide if preventive measures have to be carried out

- Radon mitigation in existing building
  Local radon campaigns, information to general public
Actions needed in radon risk areas

i) houses should be measured extensively  
ii) houses found to have elevated values should be mitigated  
iii) radon prevention should be required in new building

Cost-efficiency is the better the more precisely actions are targeted to high-radon areas
Houses measured vs. mean radon
by municipality

Municipal radon mean, Bq/m³

Houses measured

0 % 10 % 20 % 30 % 40 % 50 %

0 100 200 300 400 500 600
# Measurement activity vs. municipal / 1-km² cell mean radon

<table>
<thead>
<tr>
<th>Municipal mean, Bq/m³</th>
<th>1-km² cell mean, Bq/m³</th>
<th>Number of cells</th>
<th>Number of houses</th>
<th>Measured houses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Above 300</td>
<td>Above 300</td>
<td>1333</td>
<td>54607</td>
<td>31 %</td>
</tr>
<tr>
<td>Above 300</td>
<td>Below 300</td>
<td>2098</td>
<td>54377</td>
<td>20 %</td>
</tr>
<tr>
<td>Above 300</td>
<td>Unknown</td>
<td>3333</td>
<td>9468</td>
<td>0 %</td>
</tr>
<tr>
<td>Below 300</td>
<td>Above 300</td>
<td>2375</td>
<td>71695</td>
<td>19 %</td>
</tr>
<tr>
<td>Below 300</td>
<td>Below 300</td>
<td>20337</td>
<td>897683</td>
<td>8 %</td>
</tr>
<tr>
<td>Below 300</td>
<td>Unknown</td>
<td>73349</td>
<td>314626</td>
<td>0 %</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>102825</strong></td>
<td><strong>1402456</strong></td>
<td><strong>8 %</strong></td>
</tr>
</tbody>
</table>
A 4-km² hot-spot in Kajaani

A 4-km² local hot spot, mean 857 Bq/m³ (municipal mean 143 Bq/m³)
Elevated values were recorded in the 1990s
=> comprehensive measurements and radon mitigations,
82 % of the 422 houses have been measured.
Percentage measured again, if initially >400 Bq/m$^3$

Indicates mitigation activity

depends on the radon level of the house in question, but not on the municipal radon situation
Radon mitigation efficiency

Depends on the initial radon level of the house in question, but not on the municipal radon situation.

Graph showing the relationship between initial radon concentration and mitigation efficiency.

- Municipal mean >300 Bq/m³
- Municipal mean <300 Bq/m³
## Radon prevention vs. municipal mean

<table>
<thead>
<tr>
<th>Municipal mean, Bq/m³</th>
<th>N (survey participants only)</th>
<th>Radon piping installed</th>
<th>Proportion of houses having radon piping installed (slab-on-ground, no basement, single-family houses with building permit 2006).</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-100</td>
<td>183</td>
<td>23 %</td>
<td>(slab-on-ground, no basement, single-family houses with building permit 2006). The municipal mean radon concentration is based on all the houses measured.</td>
</tr>
<tr>
<td>100-200</td>
<td>241</td>
<td>71 %</td>
<td></td>
</tr>
<tr>
<td>200-300</td>
<td>125</td>
<td>91 %</td>
<td></td>
</tr>
<tr>
<td>300-500</td>
<td>55</td>
<td>100 %</td>
<td></td>
</tr>
</tbody>
</table>

Future: Radon prevention in energy-efficient buildings?
# Radon prevention vs. 1-km² cell mean

<table>
<thead>
<tr>
<th>1-km² cell mean, Bq/m³</th>
<th>N (survey participants only)</th>
<th>Radon piping installed (survey participants only)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 100</td>
<td>257</td>
<td>45 %</td>
</tr>
<tr>
<td>100 - 200</td>
<td>211</td>
<td>74 %</td>
</tr>
<tr>
<td>200 - 300</td>
<td>69</td>
<td>91 %</td>
</tr>
<tr>
<td>300</td>
<td>42</td>
<td>90 %</td>
</tr>
</tbody>
</table>

Proportion of houses having radon piping installed (slab-on-ground, no basement, single-family houses with building permit 2006). The 1-km² mean radon concentration is based on all the houses measured.
Radon in new vs. old houses

![Graph showing radon levels in new vs. old houses](image)

- Municipal mean radon (Bq/m³), new houses (>2004)
- Municipal mean radon (Bq/m³), old houses (<1995)
Cost-efficiency
(RADPAR project WP 7)

ÀRadon preventive measures in new building

Costs (health service not included):
Radon prevention 1000 ú
  0,016 lung cancer cases averted (high-radon areas)
  0,010 lung cancer cases averted (Finland)

ÀRadon measurement campaign + mitigation, high-radon areas

Costs (health service not included):
Invitation (195) 58 ú
Measurement (8) 257 ú
Mitigation (1) (55% of those >400 Bq/m³) 2921 ú (discounted)
Total 3236 ú
  0,036 lung cancer cases averted (high-radon areas)
Conclusions

Radon preventive measures in new building and radon measurements are clearly more common in high-radon municipalities.

Finding and recognising local hot spots within otherwise low-radon areas require more attention.