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Limits on EMF exposure and development of 5G networks in Italy

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A joint work Asstel and Politecnico di Milano

- **Context**
  - A study on the impact of the Italian limits of EMF exposure on the development of the 5G infrastructure
  - Collaboration between Asstel, the Italian association of telecommunications industry, and Politecnico di Milano (POLIMI)
  - POLIMI acted as trusted third party with operators, receiving confidential information on measurements and using them to tune a model
- **Public hearing**
  - The study has been presented to a public hearing to the Italian Parliament

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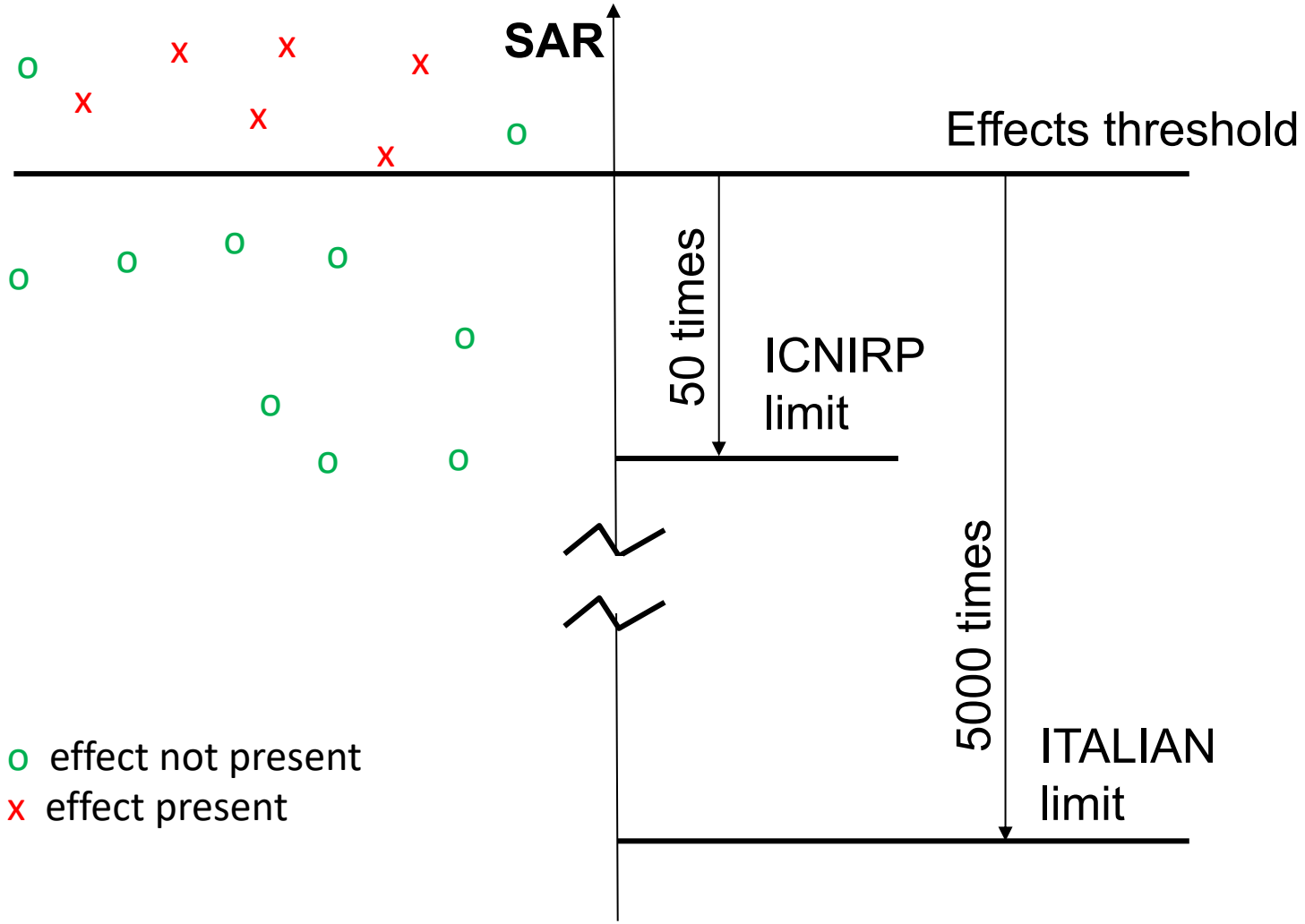
Goals and work methodology

- **Goals**
  - Analyze and present in a clear way the **international guidelines** and how they are related to the new 5G technology
  - Make a study of the **impact of Italian exposure limits** on the **characteristics and costs of the 5G infrastructure** operators will deploy

- **Work methodology**
  - **Analysis on the state of the art** of international recommendations
  - **Exercise of radio network planning** under different scenarios together with radio engineering teams of operators in order to assess the impact of exposure limits

- **Team**
  - Paolo Ravazzani (Biomediacal), Carlo Riva (EMF), Michele D'Amico (EMF), Antonio Capone (Telecommunications), Luca Dell'Anna (Telecommunications)

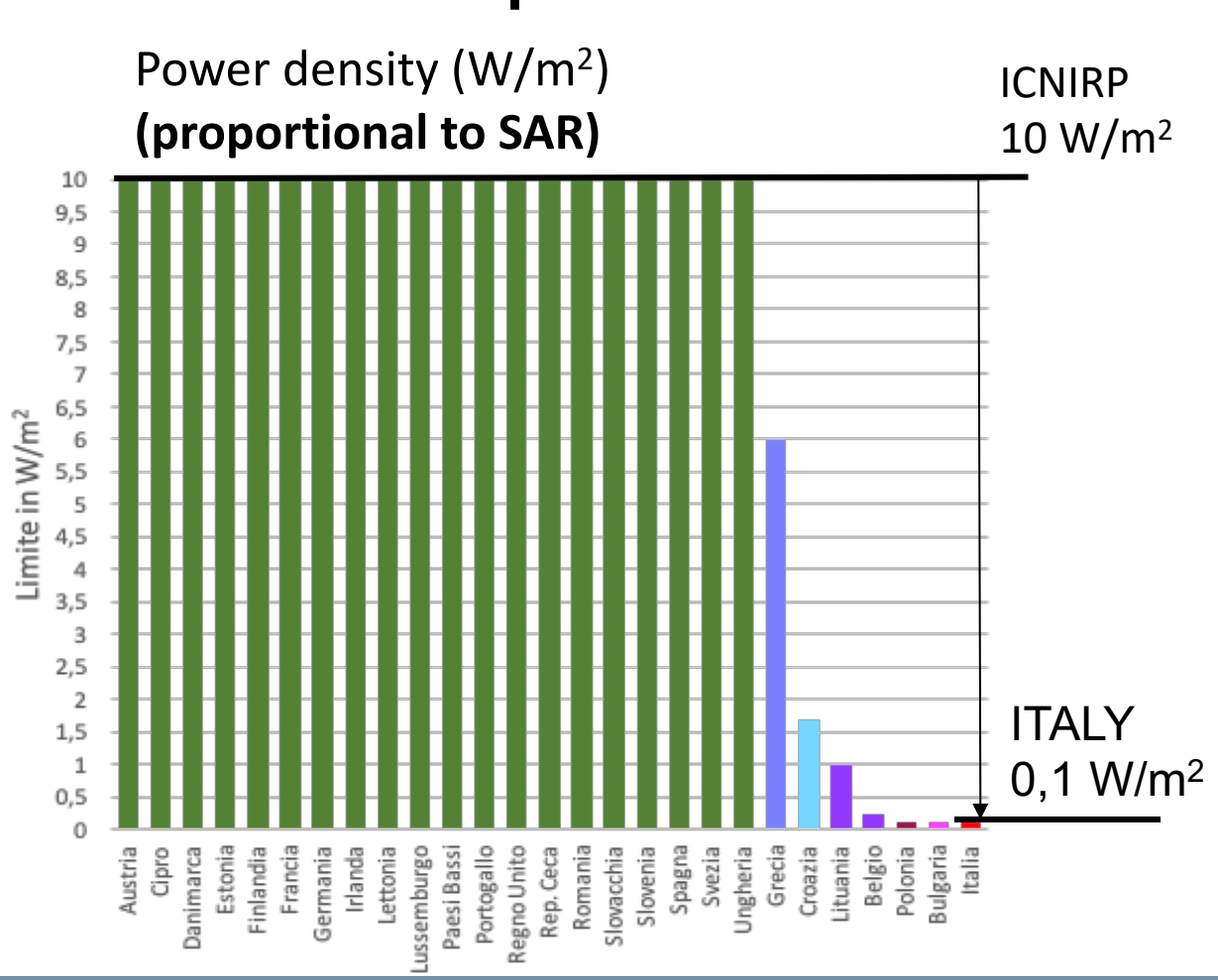
Threshold and Security Factor

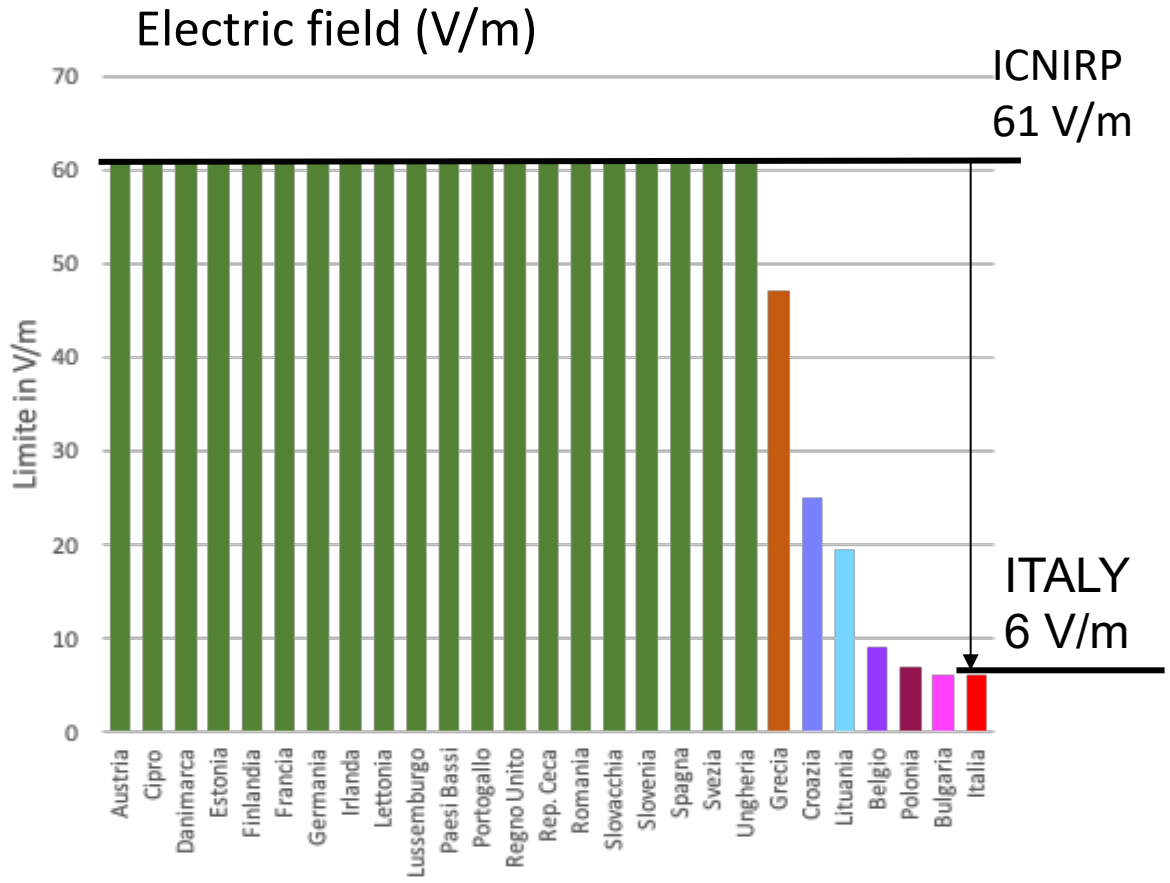


- **Analysis of all studies on effects**
  - Classification based on SAR
- **Threshold**
  - Minimum value for which effects have been detected
- **Security factor**
  - Reduction factor applied to SAR as precaution

Limits adopted by EU countries

- **Limits(*) adopted in EU:**





(*)With reference to 3.6--3.8 GHz band used in this study

Parallel with weight that can be moved by a worker

- **Threshold and limit**
  - Minimum value for which health effects have been observed

25 kg

With a reduction factor of 50 times:

500 g

Most of the other countries

With a reduction factor of 5000 times:

5 g

Italy

12 g

Writing is a risky job

Radio planning exercise

- **Goal**
  - Planning of the 5G network under scenarios with different exposure limits using electromagnetic propagation simulations and operator sites data bases
  - Estimate the characteristics and costs of the networks with the considered scenarios
  - Existing sites have been classified in:
    - **Non-upgradable sites**: these are sites that based on current limits cannot accommodate a 5G site since existing technology already saturate limits;
    - **Upgradable sites**: these are sites that probably can accommodate a new 5G base station.
  - 5 sample cities selected

- **Frequency, quality and coverage**
  - Frequency: 3.6-3.8 GHz
  - Quality: 30 Mbps at cell edge(for a bandwidth of 80 MHz)
  - Coverage: 95% outdoor, 60% indoor

Results: quality with current limits and sites

- **Very bad quality with current limits and only upgradable sites**

Cities	Coverage Outdoor	Coverage Indoor
Turin	86 %	32%
Caserta	84 %	27%
Modena	85 %	26%
Trieste	46 %	15%
Rimini	63 %	16%

Without the use of non-upgradable sites, we would expect coverage holes and this would make impossible the implementation of the 5G use cases that require coverage continuity and indoor coverage

Results: percentage of non-upgradable sites

- **On average 62% of sites is non-upgradable that projected at national level translates into 27.900 base stations**

Cities	Non-upgradable sites
Turin	68 %
Caserta	48 %
Modena	45 %
Trieste	75 %
Rimini	73 %

Base stations that are non-upgradable requires re-engineering work (like increasing height of antennas) or adding new 5G sites

While with ICNIRP limits all sites are upgradable and sufficient to meet quality and coverage targets

Results: Costs

- **As for the 27.900 base station non-upgradable, the estimated costs require an extra expenditures of 4 billions € in total**

	Scenario 1	Scenario 2	Difference
Total cost at national level	9.39 B€	5.53 B€	**3.86 B€**