Decarbonizing: from modeling to reality

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Temperature Increase

Riahi, K. et al. (2021), Nature CC
- End-of-century budget scenario design with net-negative CO₂ emissions temperature overshoot;
- Net zero budget scenarios (Rogelj et al, 2019) no net-negative CO₂ emissions limited overshoot;
- Time of net zero is when CO₂ goes to zero

Riahi, K. et al. (2027), Nature CC
What does carbon neutrality mean? Emissions sources and sinks

Illustrative zero emissions pathway

Different strategies across models when net zero

Riahi, K. et al. (2021), Nature CC
What are the investment required?

1.5°C peak temperature scenarios require rapid shift and scale-up of energy investments:

- Coal, and fossil power generation investments are eliminated nearly immediately, and gas and oil investments strongly reduced.
- Investments into decarbonizing power are dominating, especially solar and wind, plus "system" investments into transmission & distribution and storage.

Bertram, C., et al. (2021), Energy system developments and investments in the decisive decade for Paris Agreement targets, ERL.
What have we learnt?

1. Decarbonization of the Power sector is crucial
2. Efficiency!
3. Electrification of end-use
4. Preparing for negative emissions
5. Timing and Planning are critical in minimizing risks
From long term scenarios to day to day reality

**Few Reflections on Italy**

<table>
<thead>
<tr>
<th>National Targets</th>
<th>Emission Reduction vs 1990</th>
<th>Energy Efficiency</th>
<th>Renewable share in final consumption</th>
<th>Renewables share in electricity consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>2030 PNIEC (Dic 2019)</td>
<td>-37%</td>
<td>-43%</td>
<td>≥30%</td>
<td>≥55%</td>
</tr>
<tr>
<td>2030 Green Deal Fit-for-55</td>
<td>-51%</td>
<td>TBD</td>
<td>&gt;36%</td>
<td>&gt;65%</td>
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</tbody>
</table>
Renewables in Italy: where are we

Capacity Installed  Wind and Solar 2005-2021* [GW]

Annual Installation Wind and Solar 2005-2021* [GW]

RED share over consumption of electricity [%]

Source: Eurostat SHARES, Share of energy from RES in gross electricity consumption

*Data 2021 provision (Terna Transparency Platform)
Renewables in Italy: the volume challenge

- Wind and Solar Capacity in 2030 [GW]

In 2030, +40 GW for the National Energy and Climate Plan, +60/70 GW for the Green Deal.

1 GW/year in 2013-2020, we need 6-8 GW/year.
Renewables in Italy: the location challenge

- The high volumes of RES connection requests received by Terna confirm that operators are ready to invest.
- The connection requests have a distribution, both in geographical terms and in terms of voltage level, which is very different from what was predicted by the NECP (e.g. a strong growth of photovoltaics in Northern Italy was assumed).
- The territorial distribution will require investments in the grid and a continuous update in planning.
- Last three auctions: volume offered was between 10 and 25% of available volume.
- Major bottleneck: authorization delays (6-8 years for large plants).
Trasport in Italy: where are we

Passenger car registrations (Italy, 2014-21)

- 240,000 EVs as of today
- 0.5% of total vehicles

Source: European Automobile Manufacturers’ Association
Trasport in Italy: where do we need to go

- Electrification of transport from today’s 12 TWh (roughly 4% of total electricity consumption) to more than 30 TWh (9% of total).
- On the right: New Load profile assuming that recharges occur mainly during the night, peaking at 9pm.
- The impact of the installed power on the network load profile may be critical for large cities if major investments in infrastructure are not undertaken.
- **Charging modes: Smart Charging** and **V2G** change the charging profiles of an EV based on external inputs (e.g. charging price, network status). Smart Charging today more accessible in terms of technology and communication protocols.
### Challenges Ahead

**INFRASTRUCTURE**

- Network reinforcement and interconnection with foreign countries, investments to compensate for loss of inertia and voltage regulation and interventions for resilience

**RES**

- Increase installation rates, by streamlining the authorization process and suitable incentive mechanisms
- Ensure adequate security of supplies, leveraging technological differentiation
- Guarantee the coherence at the level of geographical location between planning and construction of the plants

**STORAGE**

- Construction of new hydroelectric and electrochemical storage systems to manage overgeneration and residual load ramps and provide the system with valuable services

**EV**

- Prepare the infrastructure to new load profile
- Leverage on flexible charging technologies

**MARKET DESIGN**

- Align market design with evolving energy scenarios

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**2030**
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Thank you!
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