

## DOSSIER

### COVID 19 AND THE ITALIAN POWER SYSTEM

#### THE VIRUS EMERGENCY AND ITS EFFECTS ON THE ELECTRICITY MARKET IN MARCH

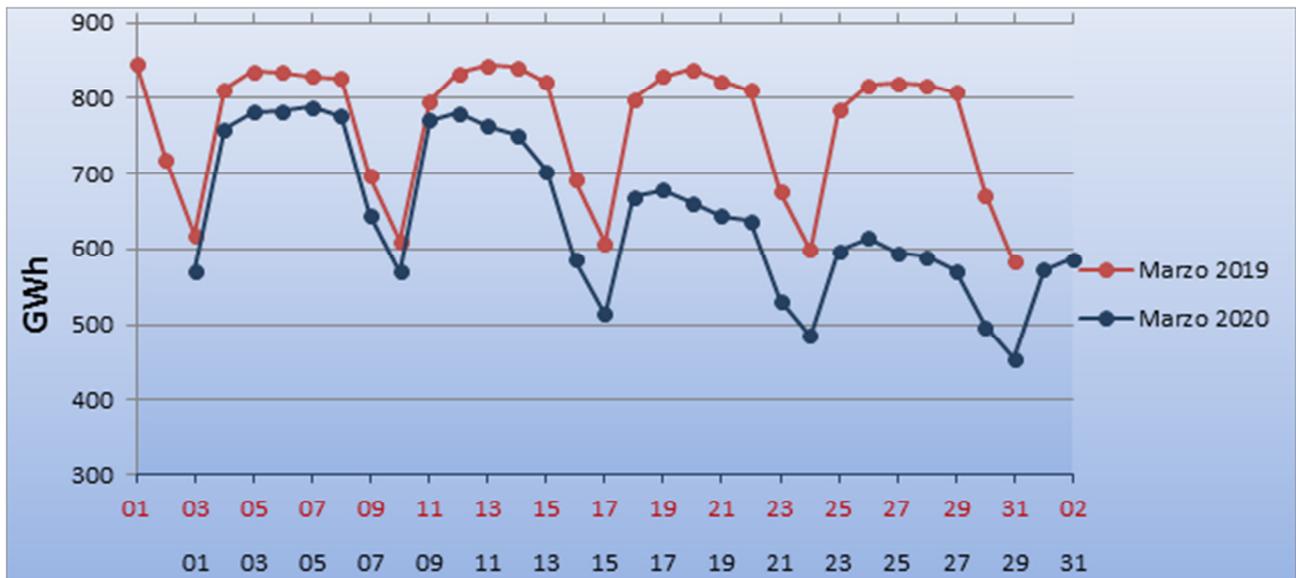
The serious situation caused by the pandemic which has affected every part of the world has generated reactions from governments to contain the contagion. In the case of Italy, which is unfortunately one of the most damaged countries, the Government has issued **two main measures**:

The **Decree “DPCM 8 March 2020”**, which implements a series of **containment measures** with reference to a specific area (Lombardy and 14 other provinces), measures soon (9 March) extended to the entire national territory;

The **Decree “DPCM 22 March 2020”**, which changes the above measures in a **more restrictive direction**, in particular by **blocking all activities defined as non-essential** or strategic.

These measures, in addition to a number of significant economic and social consequences, have generated **significant effects on electricity demand**, particularly in areas of the country with the highest concentration of productive activities. The Monthly Electrical System Report, published by TERNA (the Italian TSO), for the month of March highlights the following:

- A gradual decrease in electricity **demand**: the comparison with the same month of 2019, adjusted to take into account the climatic conditions, shows values in line with 2019 until 8 March, while in the following weeks **reductions of 5.5%, 15.6% and 24%, respectively, have been observed**
- As a result, the demand, corrected for climate effects and the number of working days **for the whole month** was **10.8% lower than** the same month of 2019.
- Interestingly, this decrease is not geographically homogeneous, but **is mainly concentrated in the North** (e.g. Lombardy -15.7%, North East -12.3%), is below the national average in the Central Regions (-8.5%) and is nearly negligible in the South and in the Islands (from -1.1% in Sicily to -3.9% in the peninsular South).



**Daily electricity demand in Italy in March 2020, compared with March 2019**

In interpreting the following data, it should be borne in mind that the virus emergency has overlapped, as early as the beginning of 2020, a situation where the natural gas price has undergone a sharp decrease: the price at the "Virtual Exchange Point" for the month of March was on average around 10 Euros/MWh, while in the same month of 2019 it was close to 19 Euros/MWh. The combination of the two factors (low demand and consequent shift of production towards greater use of low variable cost sources, and low fuel price that feeds the combined cycle systems, which are generally marginal in determining the price on the Day Before Market, MGP) has resulted in a sharp drop in MGP prices: the average "PUN" has fallen from 52.9 euros/MWh (March 2019) to 32.MWh in March 2020. It should also be noted that, in fossil fired production, the low price of gas shifts the convenience from coal to gas: if one takes into account the different efficiency typical of coal-fired power plants (net average value about 35%) compared to gas (55%) and the higher impact on coal of CO<sub>2</sub> emissions charges, the variable cost of gas production is now lower than coal.

**WHAT ARE THE CHANGES OF PRIMARY SOURCES MIX DURING THE COVID EMERGENCY ?**

Examining the contribution of different energy sources in March 2020, and comparing it with the situation in March 2019, it can be observed that **fossil fired production has fallen by 16%**, thus more markedly than energy demand, which was to be expected considering that renewable sources have very low variable production cost, and therefore the use of gas and coal is being reduced as a priority. Among renewable sources, whose production is mainly influenced by availability, **there is a sharp increase in hydropower** (up 32%) and a similarly **sharp drop in wind power** (-28%) and to a lesser extent photovoltaics (-13%). Overall, **production from renewables in March 2020 is only slightly lower than in the same month of 2019 (-4%)**.

**The hypothesis that the sharp decline in stochastic renewables was caused by production cuts** due to a level of demand not sufficient to absorb it all (assumption that could be reasonable, in a condition of net decline in demand) **is to be excluded**: on the basis of analyses carried out by RSE, production is consistently in line with that estimated based on wind and solar radiation data (e.g. , in the four weeks between 16 March and 12 April 2020, when the drop in demand is sharper, the expected wind production based on the wind data and the actual one have a difference of 4%).

Finally, it is noted that, although **pumped hydro production** remains modest at all, **it has increased significantly (36%) compared to 2019**: this can be justified by lower fossil fired production, which has reduced the availability of one of the main flexibility resources for the electrical system. Concerning the limited pumped hydro production, however, it is worth remembering that the use of pumping plants on energy markets is influenced by the level of price spread between peak hours and valley hours, which has gradually reduced over the years. In addition, pumping facilities, largely located in the north of the country, in the case of congestion on the network may be ineffective for the provision of reserve and balancing services to the southern and island areas of the country, characterized by the highest penetration of non-programmable renewable sources.

Finally, some of the pumped hydroplants are considered as "essential for the safety of the system", and their participation to energy market is subject to constraints established by TERNA.

In terms of relative weight, **renewables accounted for 42% of Italian production in March 2020, compared with 38.5% in the same month of 2019**. Fossil production was 57% in March 2020, while it was worth 60.8% in March 2019. As one can see, the mix has shifted towards renewables, but to a limited extent, because of the decline in demand (which has preferably reduced the fraction of fossil production) and low production from solar and wind sources, which tends to partially offset this effect.

It is worth noting that, in the context of fossil production, the already limited role of coal has been further reduced, from 9.4% in March 2019, to 7.7% in March 2020. This can be explained, at least partially, by the increased competitiveness of natural gas, due to the price dynamics mentioned above.

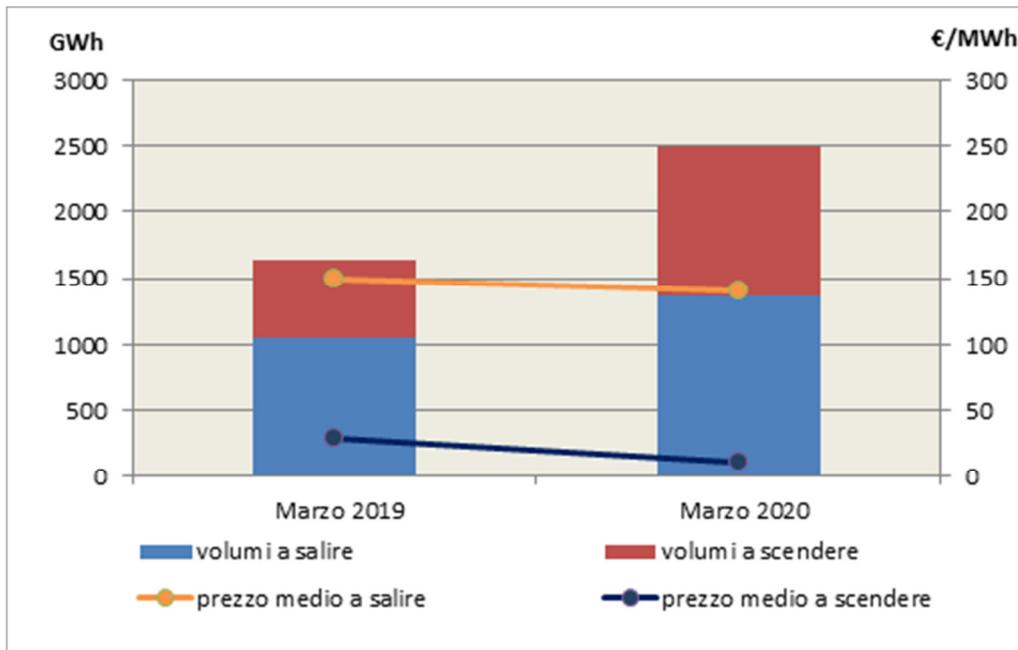
#### **THE EFFECTS ON ANCILLARY SERVICES MARKET (MSD)**

The TERNA monthly report for March 2020 shows significant changes in prices and volumes on MSD, both in relation to the previous month (February 2020) and to March 2019. In particular, **the differential between upward and downward prices was on average 8% higher than the corresponding month of 2019**, but, above all, there **was a strong increase in volumes: + 59%** compared to the corresponding month of 2019. A similar behaviour is observed for the Balancing Market (MB), with a price differential between upward and downward prices by 7% higher than in the same month of 2019, and with volumes of 24% higher.

These variations, which involve higher costs to be paid by end users, **can be explained**, at least in part, by the **reduced production by gas plants**, one of the main flexibility resources for the system, and also by a greater **difficulty in forecasting the load profiles**, in presence of a very unusual demand situation. A small share of fossil fired plants in production programmes resulting from the energy markets (MGP and MI, the intraday energy market) forces TERNA to make more operations on MSD to constitute adequate reserve margins, which in turn increases under conditions of greater uncertainty.

The other sources of flexibility is pumped hydro (PH), which has been used more than usual, but has remained **very limited compared to the related potential**: compared to about 8 GW of PH capacity, the average production (the ratio of produced energy to the hours of the month) was equivalent to a power of only 300 MW: this limited use may be explained in particular by the reduced dynamics of MGP prices, overall flattened to very low values, but increased PH participation in ancillary services would probably have a positive effect. High hydro production from natural inputs, as was said before, would in principle be

another important resource of flexibility; however, a more detailed examination shows that in this period this production is derived for the most part (over 85%) from run of river plants, or with basins of limited capacity, not able to offer a significant modulation throughout the day



**MSD prices and volumes: a comparison between March 2020 and March 2019**

#### **AN ANTICIPATION OF THE FUTURE ITALIAN POWER SYSTEM: THE DAY OF APRIL 5, 2020**

The above observations on the change in electricity demand and production mix in March 2020 are also valid for the first part of April.

In the first half of April, there were also **a few days** (Sunday 5 April, Easter Sunday 12 April, Monday after Easter 13 April) **with particularly low electricity demand**, for the overlap of the reduction of most production activities (lock-down) and the normal drop in demand on festive days. This particular situation is also highlighted by the occurrence **of some hours with zero energy price on all MGP market areas**: one hour (3pm) on Sunday 5<sup>th</sup> of April, three hours (14, 15, 16) for both Sunday 12<sup>th</sup> and Monday 13<sup>th</sup> of April. In these hours production is largely secured by sun, wind, run of river hydro, for various reasons "rigid" renewables such as geothermal and biomass, plus a significant share of gas plants (about 30% of the total) that offer zero-priced energy typically keeping to the technical minimum, in order to avoid a shutdown that would jeopardize the possibility of meeting the significant growth in demand and participate in the provision of energy in the hours around sunset, when the price also becomes significantly higher.

In particular, on 5<sup>th</sup> of April there was also a relatively high photovoltaic and especially wind production, well above the average for the period of the COVID emergency. **On April 5 2020, therefore, a day of high "de-carbonization" of electricity production** appears, due to the combination of:

- a **particularly low demand**: on average the production was 21 GW, to be compared with the average daily production of 33 GW (-36%);

- **good production from Renewable Energy Sources (RES)** and in particular from Non-Programmable Renewable Sources (sun and wind).

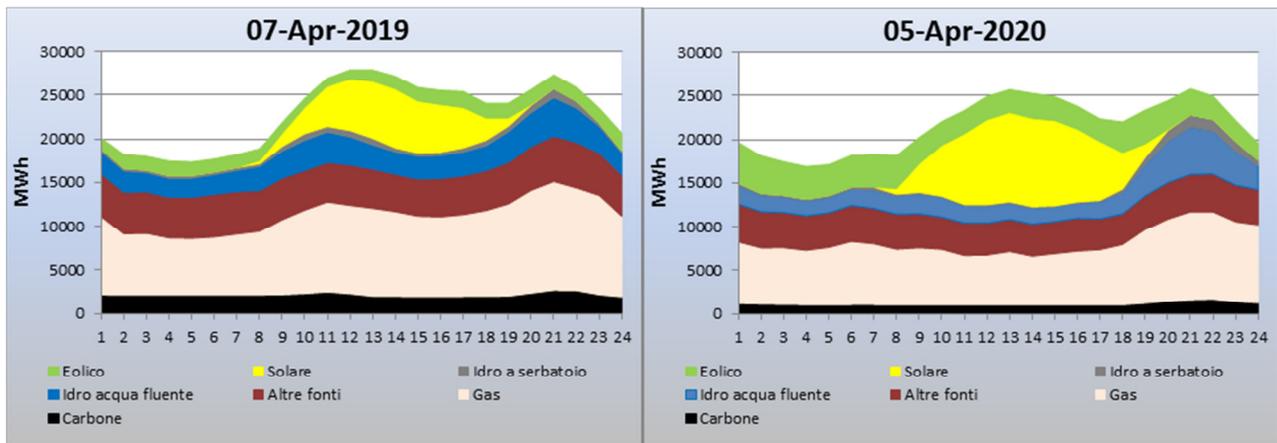
Let us consider the following data, for 4 situations:

- **Average values for the year 2018:** production from **RES 40.3%** of the total, from Variables RES (**VRES**) **14.2%**
- Average values for the day **7<sup>th</sup> of April 2019** (first Sunday in April, comparable to 5<sup>th</sup> of April 2020): **RES production 32%** of the total, **from VRES 14.4%**
- Average values for the day **5<sup>th</sup> of April 2020:** production from **RES 47.6%** of the total , from **VRES 30.6%**
- **Average values for 2030 National Climate Energy Plan (NCEP) scenario**, issued on January 2020: **RES production 60.5%** of the total, from **VRES 37.1%**.

The day **5<sup>th</sup> of April 2020** is similar, in terms of production share from VRES, to **the expected situation in 2030**, while **7<sup>th</sup> of April 2019**, in terms of FRNP, is with good approximation **representative of the year 2018**. The comparison between the power system operation over the two days (first Sunday of April 2019 and 2020) therefore tells us a lot about **how the electrical system will change in the next 10 years**.

The comparison of these two days is represented in a summary form in the table below, in which for easier reading the production from the main sources, as well as the need for reserve and the operations on MSD, are reported in terms of average power (GW).

PRODUCTION (GW)	7th APRIL 2019	5th APRIL 2020
- TOTAL	22.8	21.0
- NATURAL GAS	9.1	7.1
- COAL	1,2	0.6
- HYDRO	3.4	3.0
- SUN	2.0	3,3
- WIND	1.5	3.2
- PUMPED HYDRO	0.14	0.33
- OTHER SOURCES	5.5	3.5
SECONDARY RESERVE REQUESTED	0.45	0.54
TERTIARY RESERVE REQUESTED	3.0	3.4
MSD AVERAGE DOWNWARDS PRICE (€/MWh)	33.2	1.8
MSD AVERAGE UPWARDS PRICE (€/MWh)	207.7	146.5
MSD DOWNWARDS VOLUME (GWh)	23.5	62.5
MSD UPWARDS VOLUME (GWh)	45.2	82.3



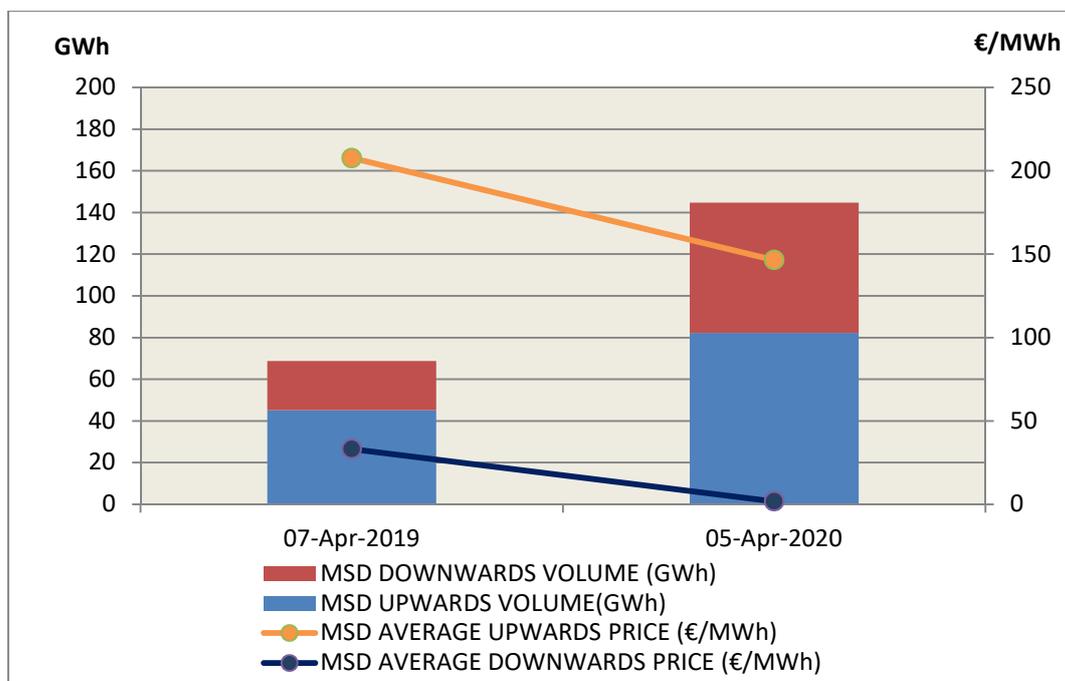
**Production by energy source – comparison between the first two Sundays of April 2019 and 2020**

The lower overall production of 5<sup>th</sup> of April 2020 is approximately corresponding to the reduction in production from natural gas. Coal is falling sharply: even in this sense, 5<sup>th</sup> of April 2020 is representative of the Italian production fleet expected in 2030, following the "phase-out" of coal.

What **flexibility resources** have enabled the system to be managed without any substantial loss of load in this situation?

- For sure, **gas production** plays a very important role: its dynamics in the day shows a minimum/maximum ratio of about 1:2 (between 5 and 10 GW). Production remained at its lowest level during the hours of peak solar production (between 10 a.m. and 3 p.m.) and peaked at 8 p.m. This dynamic, with the typical combined cycles of today, can be achieved without stops/starts, although it cannot be ruled out that some plant has been started near the evening ramp.
- **Hydro** power, although with absolute power values much lower than the gas, in terms of minimum/maximum ratio has an even more marked dynamic (almost 1:4, from 1.8 to 6.8 GW)
- **Pumped hydro** performs the typical "time shift" function, absorbing energy (up to 3.8 GW) during the hours of greatest solar production, and returning it (up to 2.4 GW) at the evening ramp. It should be noted, however, that the installed PH capacity (about 8 GW) has been exploited for less than half, so **there is room for even greater PH participation in the flexibility of the system**. It can be observed that on this particular day the action of PH was not restricted due to inter-zone congestions, which were absent during all the day.
- **Cross border exchange** contributes to meet power system flexibility needs. Significant is the case of France, for which an export of up to 1 GW is observed in the zero price hour (overproduction from VRES), and quickly moves to an import of up to 2 GW at the evening ramp. A very similar situation is observed Switzerland and, albeit with smaller absolute values, with Montenegro. Overall, it can be estimated that **import-export dynamics generates an algebraic variation of about 4.5 GW within a few hours**.
- Potentially, a further (certainly the **less efficient**) resource of flexibility can be **VRES curtailment** (particularly for wind). It is not possible to rule out that this has happened to some extent, but it is **unlikely that it has reached high values**, because situations similar to the one of 5<sup>th</sup> April occurred, albeit to a more limited extent, throughout the period between 15<sup>th</sup> March and 12<sup>th</sup> April 2020, and at this time, as discussed above, the agreement between wind production forecast and actual production is very good.

As regards **ancillary services**, it is useful to compare the data of the two Sundays taken for reference (April 7<sup>th</sup>, 2019 and April 5<sup>th</sup>, 2020). It is noted that the **reserve assessed as necessary** by TERNA **was significantly higher in 2020 (around +15%)**, while the "spread" between upwards and downwards prices is comparable in both cases, but above all that the **MSD volumes were much larger** on 5<sup>th</sup> April 2020, almost double upwards and almost triple downwards, confirming an easy prediction: In the situation of a **strongly decarbonised fleet**, in the absence of suitable regulatory reforms, **the impact of ancillary services costs tends to increase sharply**.



**MSD market – comparison between the first two Sundays of April 2019 and 2020**

Le considerazioni di cui sopra su MSD risultano pienamente confermate dal rapporto mensile di TERNA per il mese di marzo 2020, nel quale sono riportati confronti relativi a MSD ex-ante e al Mercato di Bilanciamento (MB), fra il mese di marzo 2020 e il corrispondente mese del 2019. Si veda il capitolo **“THE EFFECTS ON ANCILLARY SERVICES MARKET (MSD)”**.

The above considerations on MSD are fully confirmed by TERNA's monthly report for March 2020, which shows comparisons of MSD and Balancing Market (MB), between March 2020 and the corresponding month of 2019. See the chapter **“THE EFFECTS ON ANCILLARY SERVICES MARKET (MSD)”**.

### **SOME CONCLUSIONS**

A **particular day (Sunday 5<sup>th</sup> April 2020)** has been analysed in some detail, when the low demand typical of a spring Sunday, demand further reduced due to the lock-down, was accompanied by sustained production from renewables (RES), and in particular VRES (sun and wind). On this day an average hourly production quota of 70% from RES and 59% from sun and wind have been reached.

**This day was therefore**, much more than the annual average, **close to the situation of a highly decarbonized power system**, also thanks to the low price of gas that reduced **coal production to a minimum, simulating a kind of "coal phase out"**. It is a **situation close to the power system in 2030** designed by the National Integrated Climate and Energy Plan (NCEP).

Even if a single day of operation does not allow a full representation of the future electrical system, some interesting considerations can be drawn from this analysis.

- **Gas still plays an important role**, providing on average 35% of total production but with daily excursion about 1:2, indicating a **strong contribution to flexibility**. The possibility of making such a contribution at the most critical hours (e.g. evening ramp) may lead these plants to produce at zero price in the previous hours in order to avoid shutdown, not to run the risk of restart failure.
- **Hydro** is able to provide **another strong contribution to flexibility**, comparable to the one of gas.
- **Dynamically used cross border exchange** also contributes significantly to the stability of the system.
- **Pumped hydro** participates in flexibility, but to an extent that could be even greater.
- **Some renewable sources (biomass, geothermal)** operate as base load FER. From the purely technical point of view they can be made flexible, at least to some extent, but legal/regulatory actions are needed.
- It has been assessed **that the system operates in a stable and safe manner without cutting RES production**, or anyway with insignificant reductions.
- All this, however, involves **a need to build up and manage large reserve margins**, inevitably generating **extra costs** for customers.

In estrema sintesi: **il sistema, pur senza modifiche strutturali, è stabile**, non necessita di tagli alle rinnovabili, ma di certo si può ottimizzare, riducendo le movimentazioni su MSD. A ciò potrebbero contribuire una **maggiore accuratezza delle previsioni di produzione** (anche grazie alla riforma del dispacciamento, che dovrebbe avvicinare le contrattazioni al tempo reale), il massimo **sfruttamento degli impianti "tecnicamente" flessibili e degli scambi con l'estero**. Va anche rilevato che, a regole vigenti, **non è valorizzato il contributo di flessibilità** che può essere offerto (oltre che dalla domanda e dai sistemi di accumulo distribuiti) **dalle FRNP**, contributo da sviluppare, anche se con specificità e limitazioni. In questo assetto, la partecipazione del gas (comunque necessario per l'adeguatezza) risulta preziosa anche per la flessibilità.

In short: **the power system, even without structural changes, is stable**, does not need to cut renewables, but can be further optimized, reducing the costs related to ancillary services. This could be achieved by a **greater accuracy of production forecasts** (also thanks to the dispatch reform, which should bring energy market operation closer to real time), the **maximum exploitation of "technically" flexible plants and cross border exchange**. It should also be noted that, under the existing rules, **the flexibility contribution that can be offered by VRES, as well as demand and distributed storage systems) is not exploited**. In this conditions, gas capacity, which is necessary for adequacy, is also valuable for flexibility.