

# Covid-19 report: Update on the current epidemic status in Luxembourg

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## Background information

This report has been elaborated by the Research Luxembourg Covid-19 Task Force to inform the Luxembourg Government about the current epidemic status in Luxembourg as an update to the last report from 6 January. It gives a short overview on the most important epidemic indicators and contains projections for the current epidemic status **based on data available up to 12 January**.

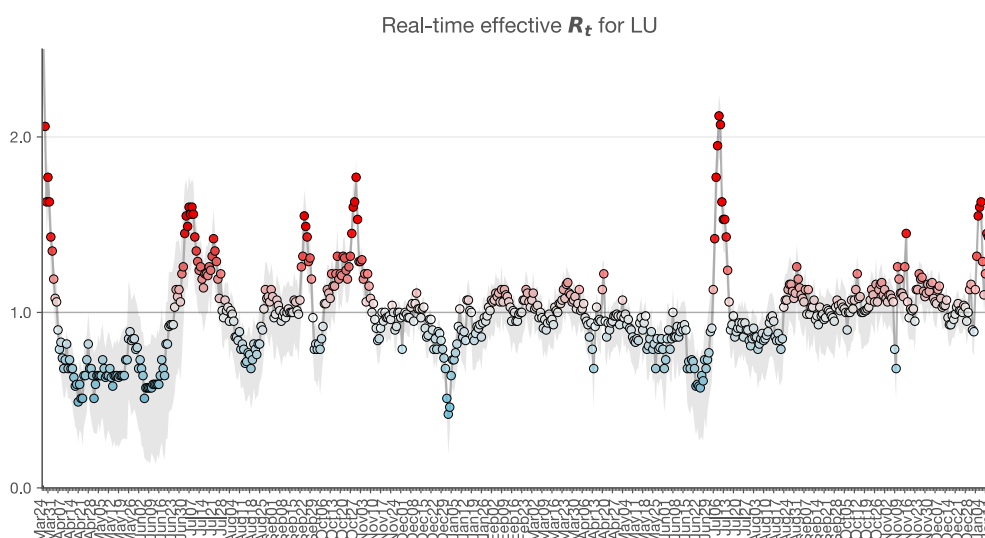
## Main conclusions

- **The development during the last week exhibits a further increase in the epidemic dynamics with some evidence for a stabilization for the last days.** Thus the 7-day average of daily cases for the current week has further increased to 1,562 cases/day compared to 1,116 cases/day for the week before but with a slightly slower rate than anticipated.
- **$R_{\text{eff}}$  of today has decreased to 1.1** compared to 1.42 on Thursday of last week (Figure 1). Also, the 7-day average value of  $R_{\text{eff}}$  has slightly decreased to 1.21 compared to 1.39 for the previous week.
- The last week exhibits an exponential dynamic with an indication for a stabilization for the last days. A linear fitting to the cumulative cases for the last month indicates an increased slope of 809 cases/day compared to 532 cases/day for last week's estimate (Figure 2 and 3).
- The 7-day average for the **normal care hospitalization demands has remained constant** compared to last week (48.7 cases on average for this week compared to 48.1 cases for last week). Also, the average **ICU occupancies has also remained constant** with 20.1 cases on average for this week compared to 19.85 cases last week.
- Based on the continuing increase in the epidemic dynamics, the current **midterm projections of daily cases indicate an increase** in the anticipated epidemic rebound with a potential peak in the 7-day average of daily cases with around 2000 cases/day beginning of February compared to more than 1,400 cases/day from last week's projection (Figure 4). Note that the projections consider the impact of the Omicron variant only implicitly and no future changes in social behavior are assumed.
- The corresponding **projections for the hospital demands exhibit an increase** for the next weeks despite the assumption of a 40% decrease for normal care and a 60% reduction of ICU hospitalization for the Omicron variant compared to the Delta variant. With these assumptions, the projections indicate a slight increase in the normal care demand of 140 beds in February compared to 120 beds from last week's projection (Figure 5). For ICU, the current projection indicates a rather stable demand of around 35 beds (Figure 6). Note that hospitalization and specifically ICU demands depend strongly on the age structure of the cases and the vaccination status of the population. Hence, it is particularly important that vulnerable people are vaccinated (including booster shots) and remain cautious in their social interactions to prevent severe cases and an increase in hospital demands.
- The **average positivity rate has further increased** to around 29% compared to 25% for last week (Figure 7).
- The total number of **estimated active cases has further increased** to 19,972 cases compared to 12,443 cases for the previous week (Figure 8).

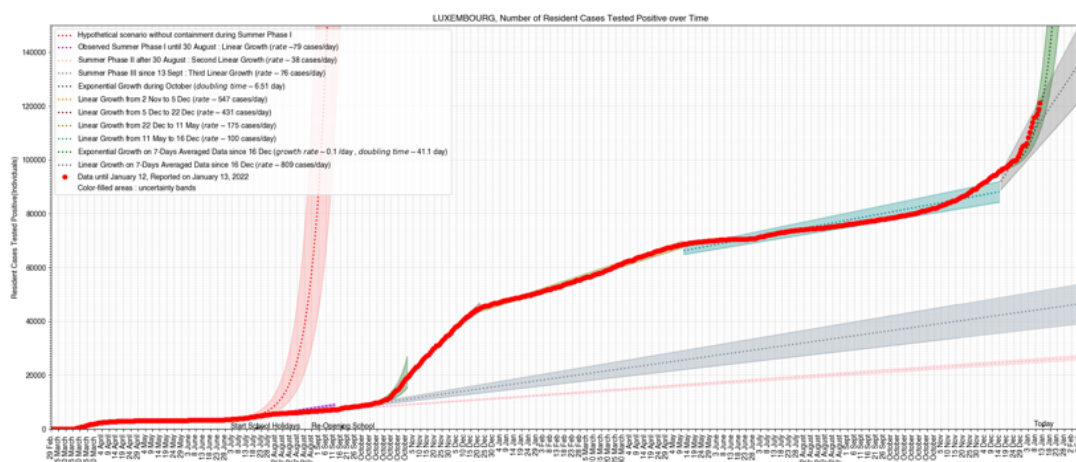
As anticipated, the presence of the Omicron variant with its increased transmissibility and partial immune evasion has further led to an increase in case numbers and significant epidemic rebound. Currently, the data on the properties of the Omicron variant is still limited and therefore its potential effects on hospitalization can only be roughly estimated. Overall, it becomes clear that hospitalization rate with the Omicron variant is lower compared to the Delta variant but data from the USA still indicate a potential significant increase in hospital demands whereas data from Denmark indicate a lower hospitalization risk. Nevertheless, the Omicron variant is likely leading to a further increase in the case numbers which might lead a significant short cut in different sectors. Hence, sustained efforts in social distancing, in following hygiene measures as well as vaccination uptake, including booster shots, will be essential to mitigate the epidemic rebound. For the future developments and mitigation, continued monitoring of breakthrough infections, virus variants and assessing their transmissibility are a key element for epidemic preparedness.

### Graphical analysis of epidemic indicators

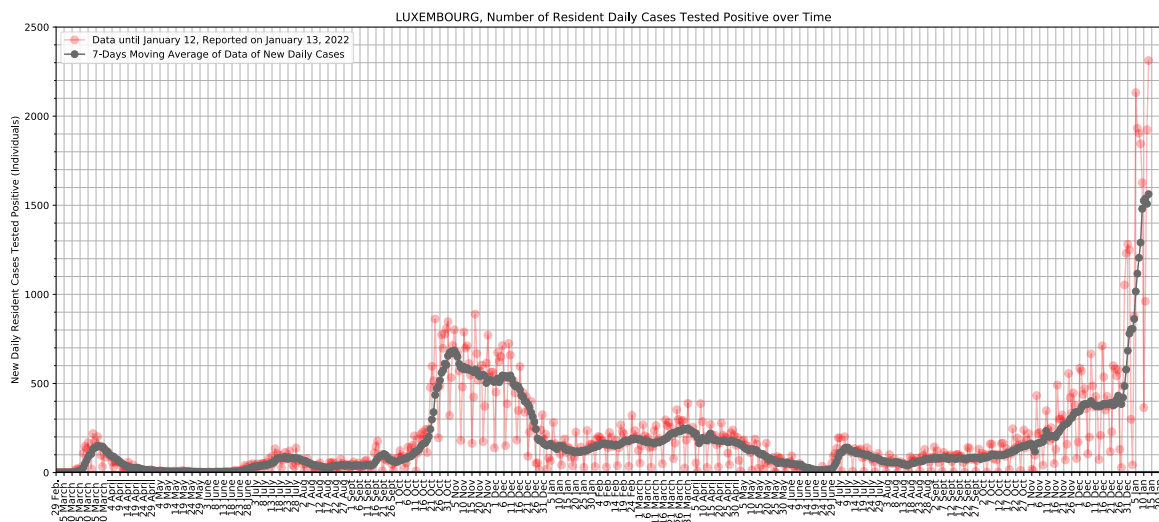
Below, the epidemic indicators are visualized and analyzed in more detail including the midterm projections for daily cases and hospitalization.



**Figure 1.** For the current week, the effective reproduction  $R_{eff}$  has decreased to 1.1 today compared to 1.42 on Thursday of last week. The 7-day average of the current week has also decreased to 1.21 compared to 1.39 of last week but remains on a high level.



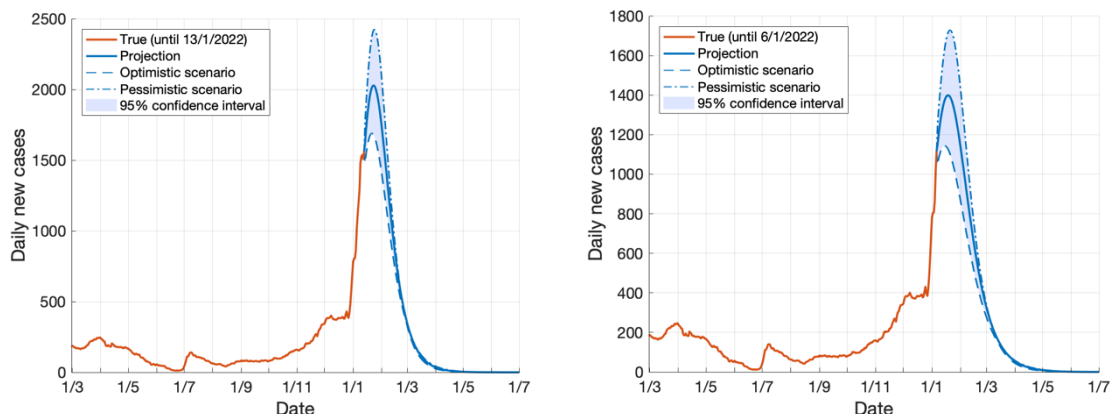
**Figure 2.** Official COVID-19 case numbers up to 12 January (red dots) were approximated with an adapted model for short-term forecasts for the different phases of the epidemics (color coded). During the last days, a trend from an exponential (green) towards a linear (grey) dynamic was observed but with the largest slope observed so far during the epidemics.



**Figure 3.** The daily COVID-19 case numbers up to 12 January (red dots) and the 7-day average (grey). Note that a linear regime is characterized by a flat curve and that an exponential behavior would correspond to a straight line. **For the current week, the 7-day average of daily cases (grey) has further increased to 1,562 cases/day compared to 1,116 cases/day for the week before.** The saturation during the last days may indicate the shift towards a linear regime but with a very large slope.

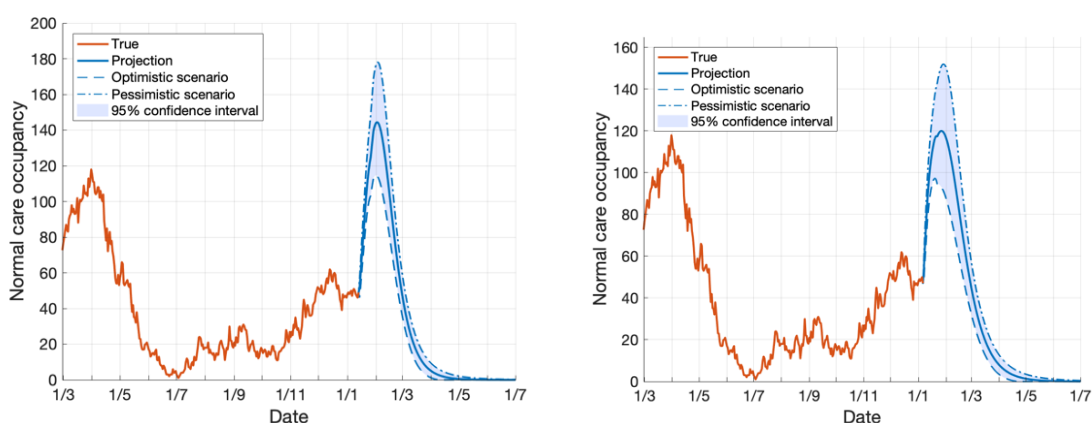
To assess the future epidemiological development in Luxembourg, we parameterized an extended epidemiological SIR model with data from Luxembourg by a Kalman filter. The model considers high and low risk groups, the current state of vaccination, and the vaccine efficacy against transmission for the Delta variant inferred from Luxembourg data as 44% and 68% for the first and the second dose, respectively, and the efficacy against severe outcome as 74% and 85%, respectively. For the Omicron variant, the transmissibility is increased by roughly 200%. However, the hospitalization risk is reduced by 40% for normal care and 60% for ICU compared to the Delta variant. Based on these assumptions and the current age-distribution of infected persons of the last two weeks, the model integrates the dynamics of daily cases, hospitalizations and ICU occupancy and projects the future development of the epidemics. Note that the model does not consider future changes in social behavior or vaccine efficacies explicitly and that the projections are accompanied by uncertainties as shown by the confidence intervals, which currently correspond to a 7% decrease or increase in social interactions for the optimistic and pessimistic scenarios (Figures 4 to 6).

The midterm **projections of the 7-day average of daily new cases** (Figure 4) estimate the current level of social interactions and consider the vaccination status. The current projections reflect the anticipated effect of the more transmissible Omicron variant. Thus, the current projection for **the 7-day average of daily cases** indicates a further increase in the anticipated peak of cases of around 2000 cases/day for the next weeks (Figure 4 left) compared to a peak of around 1400 cases/day from last week's projections. In the pessimistic scenario, the current upper bound corresponds to a 7% increase in social interactions and indicates an epidemic rebound with a peak of more than 2400 cases/day. Since data on the Omicron variant is still not coherent, the projections are accompanied by some uncertainties and therefore the effect of the Omicron variant can only be roughly estimated based on epidemic data from other countries. Currently, the available data from Luxembourg are analyzed and will be integrated in corresponding projections.



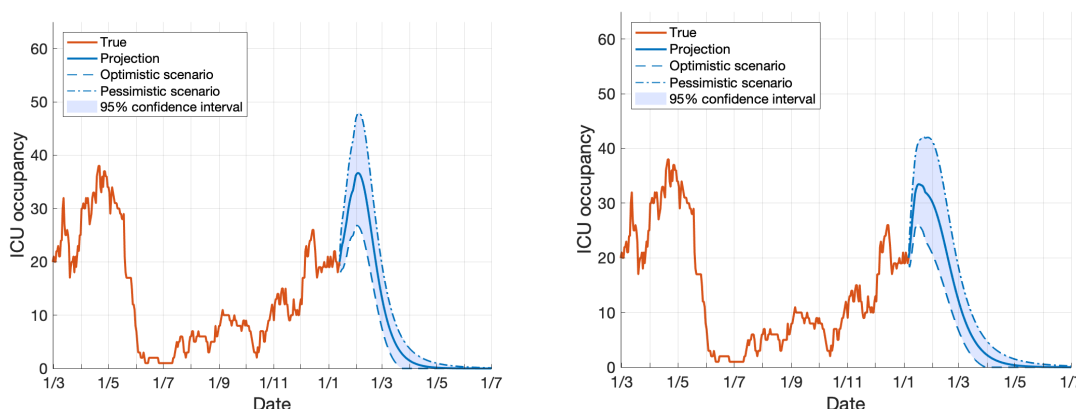
**Figure 4.** Comparison of midterm projections for the 7-day average of daily cases from this week (left) and the week of 16 December (right) based on an extended epidemiological SIR model parameterized to the situation in Luxembourg data by a Kalman filter. The blue solid line represents the most likely scenario whereas the optimistic (dashed line) and pessimistic scenarios (dashed-dotted line) correspond to a 7% decrease and increase in social interactions for this week's and 10% for last week's projections, respectively. **The comparison indicates a further increase driven by the Omicron variant with an anticipated peak in the 7-day average of around 2000 cases/day in February compared to 1400 cases/day in the projection from last week (right).**

The model **projection for normal care** assumes a 40% decrease in the hospitalization risk for the Omicron variant compared to the Delta variant. Therefore, the increase in case numbers (Figure 4) is not mimicked in the increase of the anticipated normal care demands of around 140 beds in February compared to 120 beds in the projection from last week (Figure. 5). This dynamic is based on the case numbers shown in Figure 4 and the current age distribution of cases. For the normal care demands, the epidemic rebound might still lead to a more significant increase in hospitalizations as shown by the pessimistic scenarios with a 7% increase in social interactions, which could lead to an increase in hospital demands of around 180 beds in February (Figure. 5 left). Note that hospitalizations strongly depend on the age distribution of cases since older people are more likely to develop severe symptoms and that in particular for the Omicron variant booster shots are essential to push down the curve. Furthermore, a stronger reduction in the hospitalization risk for the Omicron variant compared to the Delta variant may lead to less demands. Hence, changes in the age structure and admission of booster shots can induce changes in the projections accordingly.

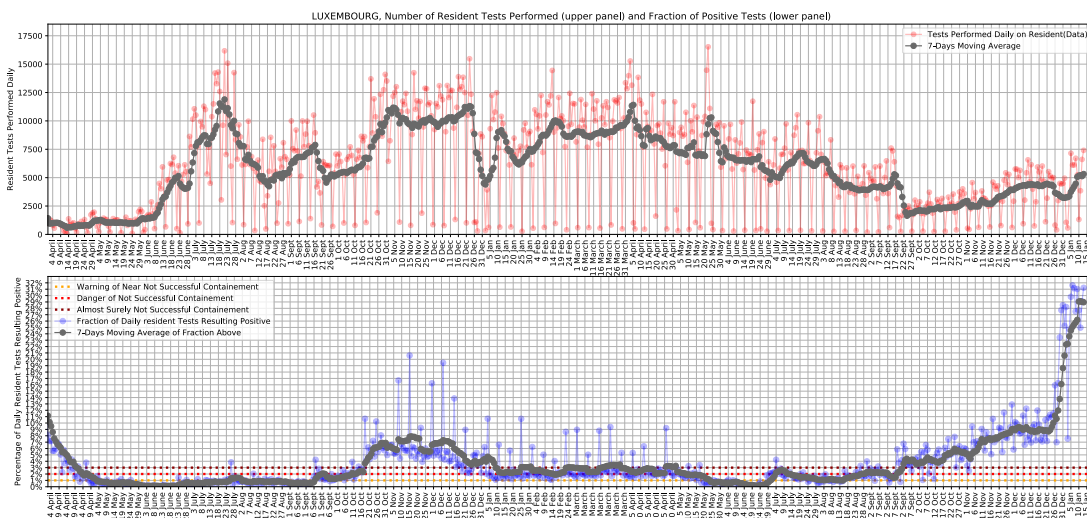


**Figure 5.** Comparison of midterm projections for the 7-day average of normal care demands from this week (left) and last week (right) based on the extended epidemiological SIR model. The blue solid line represents the most likely scenario whereas the optimistic (dashed line) and pessimistic scenarios (dashed-dotted line) correspond to a 7% decrease and increase in social interactions, respectively for this week and 10% for the projections from 16 December. **The comparison indicates a strong increase in normal care demands to around 140 beds in February (left) compared to a peak of 120 beds in the projections of last week (right).** The volatile epidemic regime could lead to a more significant increase in normal care demands as shown by the pessimistic scenario with a 7% increase in social interactions leading potentially to nearly 180 cases in February.

The corresponding **projections for ICU demands** also show an effect of the Omicron driven epidemic rebound where the evidence for reduction in severe cases for the Omicron variant and the current age distribution of cases exhibit only a mild increase to around 35 ICU beds for the next weeks (Figure. 6 left) similar to the peak from the projection of last week (Figure. 6 right). The pessimistic scenario with a 7% increase in social interactions indicates more than 40 ICU cases in February similarly to the estimate of the pessimistic scenario of last week. Note that hospitalization and specifically ICU demands depend strongly on the age structure and vaccination status of cases. Hence, it is particularly important that vulnerable people are vaccinated (including booster shots) and remain cautious in their social interactions to prevent severe cases. With the strongly increasing number of cases, the protection of the vulnerable people becomes more challenging and requires frequent testing. Furthermore, the current data on the hospitalization risk for the Omicron variant is still not coherent and therefore the projections are accompanied by uncertainty. In this respect, the next week will be crucial since typical delay between case numbers and hospitalization is around 14 days and therefore hospitalizations may go up next week in response on the epidemic rebound if the Omicron variant does not exhibit a significant reduced hospitalization risk.

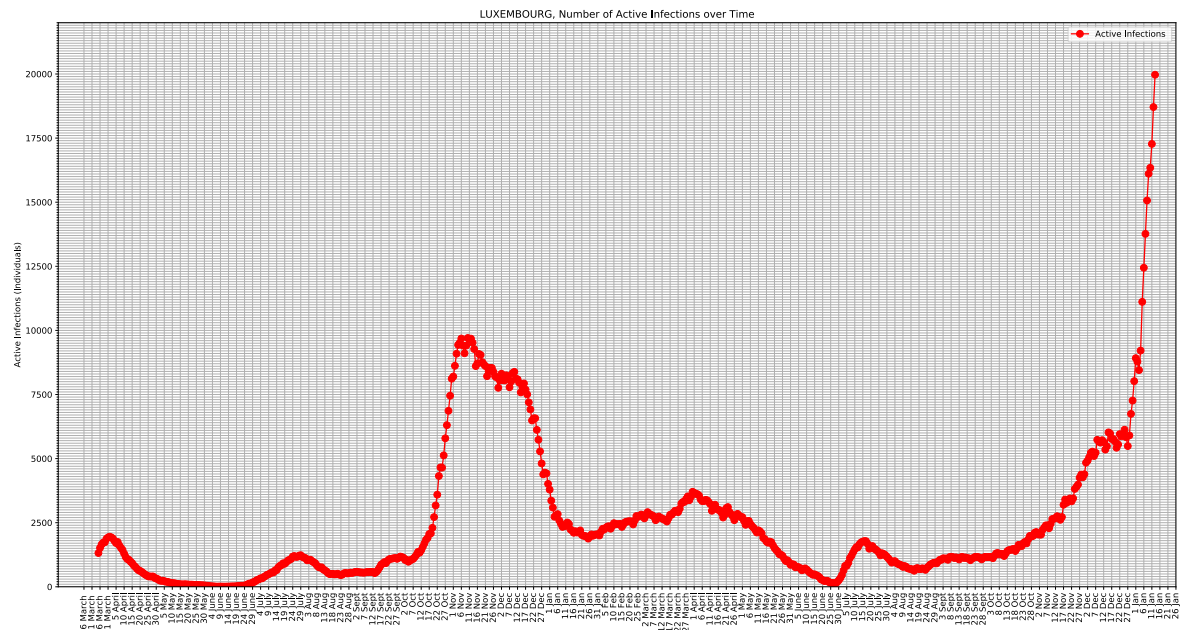


**Figure 6.** Comparison of midterm projections for the 7-day average of ICU demands from this week (left) and last week (right) based on the extended epidemiological SIR model. The blue solid line represents the most likely scenario and the optimistic (dashed line) and pessimistic scenarios (dotted-dashed line) correspond to a 7% decrease and increase in social interactions, respectively for this week and a 10% decrease and increase for the projection of 16 December. **The comparison exhibits a rather constant ICU demand of around 35 ICU beds during the next weeks (left) compared to the peak in last week's projections (right).** The current pessimistic scenario with a 7% increase in social interactions also shows a potential increase to around 50 ICU beds in February. Note that the potential effects of the Omicron variant can only be roughly estimated at the moment given the limited available data.

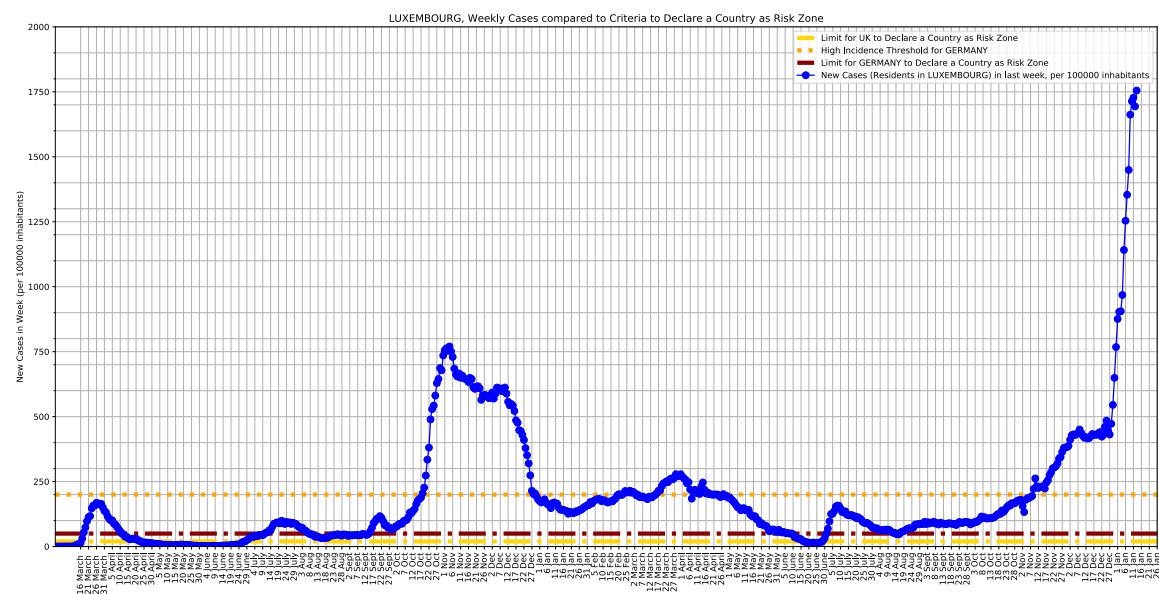


**Figure 7.** Number of daily tests performed (top) and overall normalized positive tests (bottom). **During the current week, the 7-day average of positivity rate (grey) has further increased to above 29% compared to around 26% last week.**





**Figure 8.** During the current week, the number of estimated active cases has further increased to 19,972 cases compared to 12,443 cases last week.



**Figure 9.** Number of weekly cases per 100,000 inhabitants that is used by different countries to set thresholds for risk zone definitions such as Germany with 50 cases per week and per 100,000 inhabitants (dark red line). During the current week, the number of weekly cases per 100,000 inhabitants has again increased to 1750 cases for this week compared to around 1250 cases last week with some evidence of a saturation.