



5G business value - A case study on real-time control in manufacturing - Sustainability Appendix

CASE STUDY



Contents

1	Calculations of greenhouse gas reductions	3
1.1	Environment.....	3
1.1.1	In production.....	3
1.1.2	Operation of jet engine.....	4
2	Methodology and assumptions	5
3	References	6



1 Calculations of greenhouse gas reductions

This is an appendix to the Ericsson Consumer & IndustryLab report “5G business value - A case study on real-time control in manufacturing”¹.

This appendix focuses on detailing the calculations for the reduction of greenhouse gas emissions related to the decreased production time and increased quality of BLISKS which 5G enables. It does not consider the added value from the potential reductions in material waste in the production process.

1.1 Environment

The adaptive control over the production system enabled by 5G leads to less machine failure and as a result, rework and waste get reduced and the production becomes more optimized. Experiments at Fraunhofer Institute for Production Technology (IPT) has showed that thanks to the sensor system, the production time could be reduced by 12% due to the improved product quality². Shorter production time is assumed to give a corresponding decrease in electricity consumption and thereby in CO₂-equivalent (CO₂e) emissions.

1.1.1 In production

Reduction per BLISK

Assuming that the milling process consumes 1 kW of electricity per hour, energy savings from improving the rework rate by 10 %-points would amount to 6 kWh / BLISK.

6 kWh/BLISK * 0.6 CO₂ kg/kwh = 3.6 kg CO₂e / BLISK (Global electricity is estimated to have an emission factor of 0.6 kg CO₂e / kWh including supply chain and distribution losses)

Total reduction

100 000 (estimated total annual production of BLISKS) * 3.6 = 360 metric tons less CO₂e emissions for total annual BLISK production.

¹ Document number: GFTB-18:001245 Uen

² A decrease of the rework rate from 25% to 15%, means a 10 percentage points decrease (which is the same as a decrease of 40 percent). With a median machine time/BLISK of 50h, a 10-percentage point drop in rework, means a 6 h shorter median machine time/BLISK, which is the same a 12% decrease.



Parameters	Savings
Electricity/BLISK	6 kwh
CO ₂ e /BLISK	3.6 kg
CO ₂ e /total global annual production	360 metric tons

To put these savings into perspective, consider that the average CO₂e emissions per person in Sweden amounts to some 11 metric tons per year (this is called consumption-based emission that includes all transport, construction and so on relevant emissions) [1], which means that the CO₂e savings from the BLISK production alone is equivalent of the total annual emissions from more than 32 swedes.

1.1.2 Operation of jet engine

Further reductions in CO₂e emissions could also be expected related to the operation of the jet engine and the improved BLISK quality.

By increasing the quality of production, the produced BLISKS will operate more efficiently, meaning that the fuel consumption will be reduced, which in turn will lead to lower CO₂e emissions.

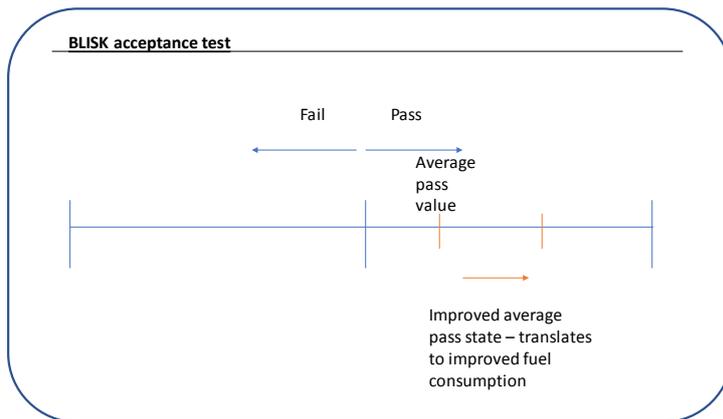


Figure 1: Improving the average approved BLISK quality

The precision of the used engine components has a clear effect on the fuel consumption. For a typical jet engine, fuel consumption could increase by up to 4-5% from the newly produced to the first maintenance [2], and the variance of performance is around 2%.

Since fuel makes up as much as 30 percent of a typical airline's cost structure, the decreased cost of fuel is another welcome improvement, even if it is not included in these calculations. [3]

Assuming that 2% higher efficiency is achieved on average, CO₂e emissions would be reduced by 16 million metric tons, as can be seen in the calculation below.



Total yearly global CO₂e emission from jet engine fuel consumption is derived as:

- Total global jet fuel consumption per year is ~312 million m³ [4]
- 312 million m³ * 2.55 (metric tons CO₂e/m³ fuel) ~ 796 million metric tons CO₂e

Parameters	
Total global jet fuel consumption per year	312 286 335 m ³
CO ₂ e per m ³ conversion factor ³	2.55
Total global CO ₂ e emission from jet engine fuel consumption per year	796 million metric tons
Total global CO ₂ e emission reduction, assuming 2% efficiency gain	16 million metric tons

Using the same comparison as earlier, these savings equal the total annual consumption-based CO₂e emissions of approximately 1 400 000 people in Sweden, or put another way, more than the population of the capital of Sweden; Stockholm!

Another way to view these savings, is to compare them with flying. 16 million metric tons of CO₂e is the same amount that 4.4 million people flying from London to Bangkok would emit!⁴

These savings correspond to 0.07 % of total global GHG emissions from the industry sector (energy, raw materials and other) as the total global industry GHG emissions are 20 714 million metric tons CO₂e [5].

2 Methodology and assumptions

This case study is part of an Ericsson 5G for Industries series, in which we look more closely at the actual business values associated with introducing mobile connectivity.

All information, if not otherwise stated, is based on discussions and interviews with the Fraunhofer Institute for Production Technology (IPT) carried out as part of a study - conducted from January to March 2018.

Generally, the assumptions in this report are based on estimated typical values emerging from these discussions.

Note that this report does not consider the footprint of the 5G system. From previous case studies this footprint is expected to only marginally impact the results and conclusions, but more detailed studies would be needed to confirm this.

³ UK Government GHG Conversion Factors for Company Reporting, 2016

⁴ https://co2.myclimate.org/en/flight_calculators/new



3 References

- [1] <http://www.naturvardsverket.se/Sa-mar-miljon/Statistik-A-O/Klimat-vaxthusgasutslapp-fran-svensk-konsumtion-per-person/>
- [2] Interview with SAS expert, 2018-02-22
- [3] ACARE Roadmap Flightpath 2050:
<http://www.acare4europe.org/sria/research-programs>
- [4] <https://www.indexmundi.com/energy/?product=jet-fuel>
- [5] Jens Malmodin, Pernilla Bergmark, "Exploring the effect of ICT solutions on GHG emissions in 2030", Ericsson 2015