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| R-ENV-GR-0025 | CO₂ Emissions – 17810 Moray East OTM's | | Rev.: | 2-0 |
| | | | Date: | 20/01/2020 |
| Author: | Tim Balcaen | Validated by: | Carla Wellens | |

1 Scope

Since 2014, Smulders calculates on a yearly basis its CO₂ emissions as part of the CO₂-Prestatieladder. This inventory is divided into 3 scopes:

- Scope 1: Direct emissions
- Scope 2: Indirect emissions
- Scope 3: Other indirect emissions

Smulders' calculations include scope 1 and 2 emissions. These are the emissions from own activities, not taking into account emissions from resources, transport, maintenance,...

Smulders also made a general scope 3 calculation for every other source of emissions outside of scope 1 and 2, and a detailed Life Cycle Analysis for its two main resources, being steel and paint. These calculations are based on figures from 2017.

2 Field of Application

Based on the calculations, the three Offshore Transmission Module from the Moray East project result in the CO₂ emissions stated below.

3 Definitions and abbreviations

| | |
|-----------------|---------------------------------|
| CO ₂ | Carbon dioxide (greenhouse gas) |
| ENV | Environment, environmental |
| HDG | Hot Dip Galvanised |
| LCA | Life Cycle Analysis |

4 Resources used

Resources for the Moray East OTM's:

- Steel 1.230 tons
- Coating 56,25 tons
- Hot Dip Galvanized Steel 1,5 tons

4.1 Scope 1 & 2 – Emissions from Smulders' activities

The scope 1 and 2 emissions are based on the calculations from 2017 and related to the amount of steel that was processed. As HDG steel is only assembled at Smulders, the scope 1 and 2 emissions related to HDG steel are null.

| | Smulders total 2017 | Moray East OTM's |
|---|-------------------------------|--------------------------------|
| Total steel processed | 71.756,0 tons | 1.230,0 tons |
| CO₂ emissions (scope 1 & 2) | 16.219,0 tons CO ₂ | 278 tons CO₂ |

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4.2 Scope 3 – Emissions resulting from Smulders' activities

Scope 3 conversion factors for steel, paint and HDG steel come from the LCA studies that Smulders conducted.

The scope 3 emissions from steel, paint and HDG steel represent 78,40 % of Smulders' total scope 3 emissions. Thus the multiplying factor of 1,275 to calculate the total scope 3 emissions.

| | Resources | Conversion factor | CO ₂ emissions | |
|------------------|--------------|----------------------------|------------------------------|--------------------------------------|
| Steel | 1.230,0 tons | 1,39 CO ₂ / ton | 1.709,7 tons CO ₂ | Representation: 1,275 x ∑ |
| Coating | 56,25 tons | 4,52 CO ₂ / ton | 254,3 tons CO ₂ | |
| HDG Steel | 1,5 tons | 3,97 CO ₂ / ton | 6,0 tons CO ₂ | |
| Total | | | 1.969,9 tons CO ₂ | |

5 Life Cycle emissions from the Moray East OTM's project

The CO₂ emissions that are produced during the entire life cycle of the transition pieces is equal to the sum of the scope 1, 2 and 3.

| | |
|---|------------------------------------|
| Life Cycle CO ₂ emissions for Moray East OTM's | 2.789,6 tons CO₂ |
|---|------------------------------------|

The CO₂ payback time, being the time a turbine takes to compensate for the CO₂ that is produced during its lifetime by replacing grey energy, averages from 9 to 12 months, depending on the turbine type and location.

Taking into account the Moray East's peak capacity of 950 MW, an efficiency of 24,3% (wind) and a Western European equivalent for grey energy of 0,649 ton CO₂ / MWh, payback time for the OTM's is less than 1 day.

$$950MWp \times 0.243 \times 365d \times 24h = 2.022.246MWh \text{ energy produced per year}$$

$$2.022.246MWh \times 0.649 \frac{\text{tons}}{\text{MWh}} = 1.312.437,7 \text{ ton CO}_2 \text{ saved per year compared to grey energy}$$

$$\text{Payback time} = 2.790 \text{ tons} \div 551733 \frac{\text{tons}}{\text{year}} \times 365 = 0,78 \text{ days} = 18,62 \text{ hours}$$

6 Bibliography

<http://www.smulders.com/nl/co2-management>