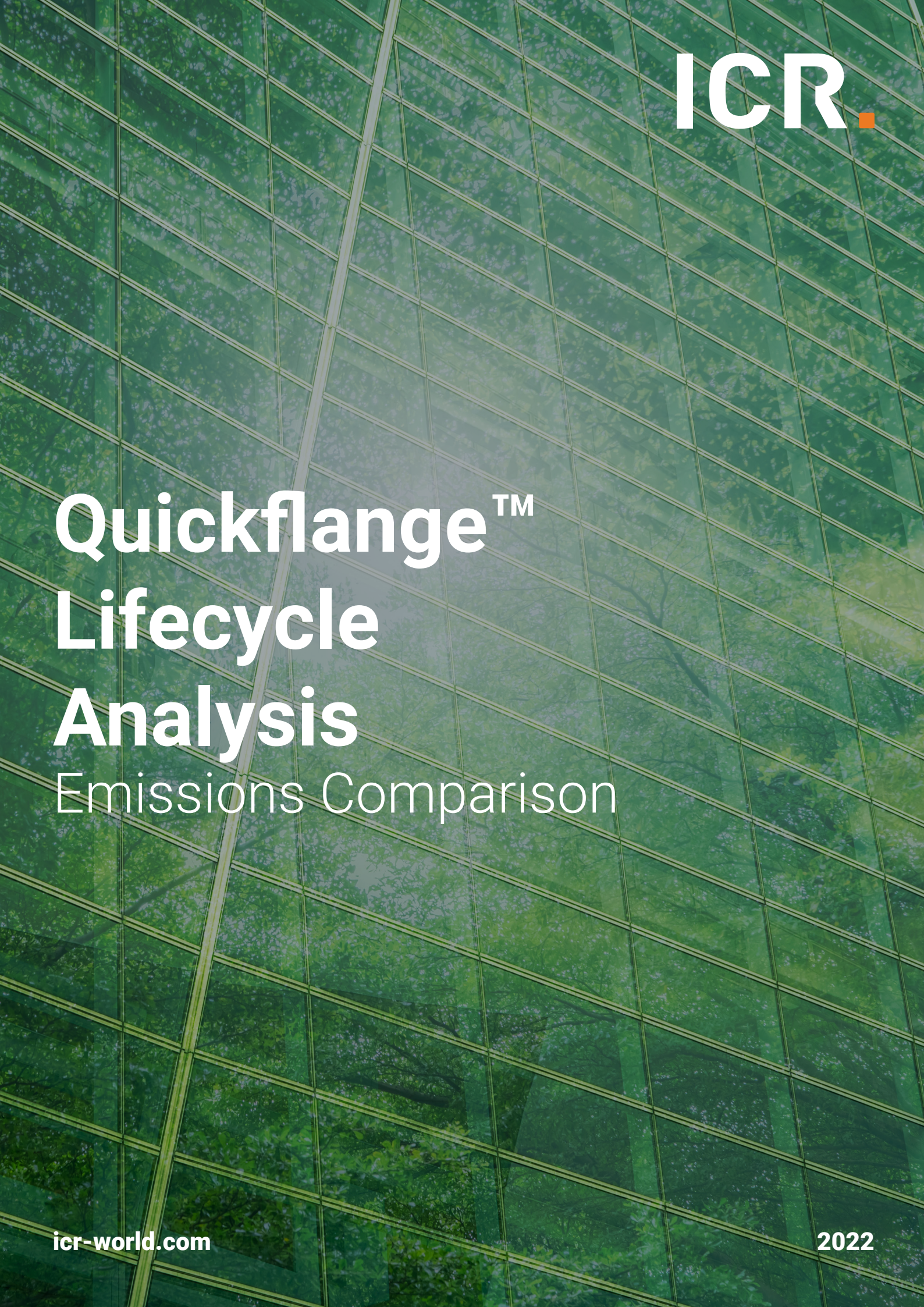


Quickflange™ Lifecycle Analysis

Emissions Comparison

icr-world.com

2022

Overview

As a leading provider of engineered repair solutions, ICR supports clients with a wide range of pipework, pipeline, caisson, and structural integrity challenges.

Our patented Quickflange™ technology has a proven track record of almost 20 years. It offers an industry leading cold work solution to clients looking for a permanent repair option for improving pipeline integrity and flow assurance eliminating the need for welding or hot work.

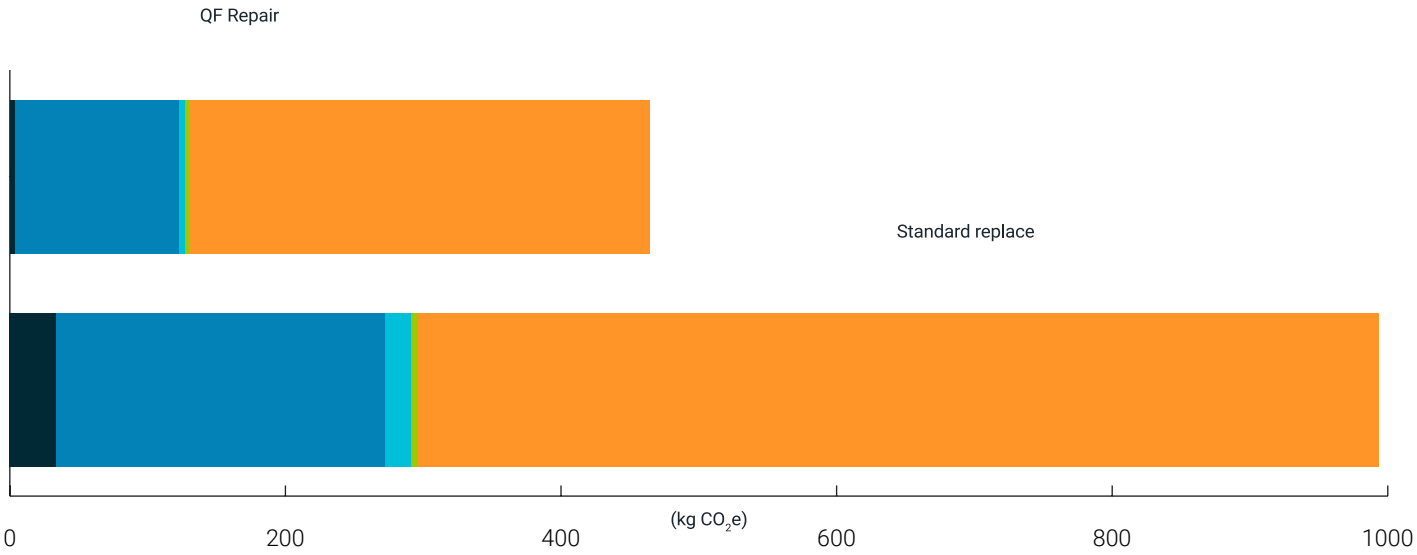
With an extensive range, Quickflange™ is a safe, cost-effective and efficient solution generating up to 80% time saving and 57% reduction in greenhouse gas (GHG) emissions over traditional welding. Welding and hot work are energy intensive processes requiring multiple materials whereas the Quickflange™ technology offers a straightforward repair system that is less energy intensive and requires fewer specialist engineers.

The Quickflange™ system has a lifetime equal to that of traditional welding repairs and as such is directly comparable. We have compared the carbon impact of using our repair system technology for the repair of a 2-metre section of 8" carbon steel pipework (85.1 kg) located 225 miles offshore from Aberdeen. We found that our repair system gave a total reduction in emissions of 39% compared to the traditional replacement method.

Scenario Overview

For the purposes of this calculation, we considered the scenario where a 2-metre length of 8-inch-diameter piece of carbon steel pipework has been damaged and either needs to be replaced either through welding (traditional method) or using the Quickflange™ system.

	QF Repair (kg CO_2e)	Standard replace (kg CO_2e)
Energy consumption	3.3	33.5
Transport – helicopter	119.1	238.2
Transport – sea	4.7	18.9
Transport – land	2.9	5.4
Material production	334.4	697.2



69%
reduction in materials transport (land and sea)

52%
reduction in material production

90%
reduction in energy demand

50%
reduction in personnel transport*

* It should be noted that in this scenario we have assumed that the Quickflange™ route requires 1 person to be mobilised from shore however due to the simplicity of the system it is possible to have trained personnel on the rig and as such these emissions could also be avoided

Transportation Calculation

It is assumed that the pipework is located on an offshore oil rig located 225 miles (360 km) offshore. All equipment and materials, for both scenarios, is assumed to be in a warehouse 4 miles (6.4 km) from the port from which it can be shipped to the oil rig. The general process is assumed to follow a similar route as laid out below:

- Materials and equipment are transported by land (Rigid HGV (>3.5 – 7.5 tonnes)) from the warehouse to the port.
- Materials and equipment are transported by sea (general cargo ship, 0 – 4999 dwt)
- Repair is carried out.
- Materials and equipment are transported by sea back to the port (general cargo ship, 0 – 4999 dwt)
- Materials and equipment are returned to the warehouse by land (Rigid HGV (>3.5 – 7.5 tonnes))

For this calculation we estimated the weight of all materials and equipment required for either the weld or Quickflange™ scenario and then calculated the associated carbon footprint by multiplying the total weight by the distance travelled by the tonne.km conversion factor for the appropriate transport type. Calculations were performed using emissions factors published by DEFRA.

Emissions [kgCO_2e] = Weight of Materials and Equipment [tonnes] × Distance Travelled [km] × Emission Factor

Transportation of personnel by helicopter was calculated using published data on helicopter fuel consumption[1]. It was assumed that the helicopter maximum passenger occupancy was 19 and as such each passenger would be responsible for 1/19 of the journey's emissions.

Total Emissions [kgCO_2e] = Distance of flight [km] × Fuel Consumption per km [l/km] × Emission Factor

Passenger Emissions [kgCO_2e] = Total Emissions [kgCO_2e] ÷ 19

1 R. Villasenor et.al. Atmospheric Environment, 37, 2003, 3713 – 3729. DOI: 10.1016/S1352-2310(03)00445-X

Materials Calculation

To calculate the emissions associated with the production of the materials required for the different scenarios weight and composition data was collected for consumable materials required for each method. Once weight and composition data had been collected the appropriate emissions factor was applied. Where possible "market for" emissions factors were used which encompass the full cradle to gate emissions associated with production and transportation. Where consumables were formed of multiple different materials, emission factors were applied to proportionate amounts of the items total weight composition. Emissions factors were taken from the Ecoinvent LCIA database.

Emissions [kgCO_2e] = Weight of Materials [kg] × Material Emission Factor

In some instances where processing of material was required to produce a consumable an appropriate emission factor was applied:

Emissions [kgCO_2e] = Weight of Materials [kg] × Processing Emission Factor

It should be noted that equipment that was reusable was excluded from this calculation as it is assumed that the equipment would not be purchased exclusively for this job and that lifetime of the equipment would make its contribution to the calculation negligible.

Energy Consumption Calculation

To calculate the energy required for the two scenarios a list of equipment and the associated power required was produced. By estimating the amount of time equipment would be running for it was possible to estimate the total electrical consumption required to carry out each scenario. Calculations were performed using emissions factors published by DEFRA.

Emissions [kgCO_2e] = Energy Consumption [kWh] × Emission Factor

It should be noted that in the calculation for the replacement process we have included the use of a pressurised habitat which is optional. Without this the energy consumption carbon footprint would reduce by 10.2 kgCO_2e (~30 % of energy consumption emissions)

Calculation Data – Quickflange™ System

Qty	Description	Description	Value	Unit	kg CO_2e
1 off	Fabricated spool piece with flanges	Carbon Steel	81.50	kg	212.90
2 off	QF connectors	Carbon Steel	26.00	kg	67.92
1 off	Box of rags	Textile Towelling	4.00	kg	45.47
1 off	Disposable Gloves	Disposable Gloves	0.50	kg	4.79
1 off	Temporary lighting	Energy consumption 80 watts / hour	15.34	kWh	3.26
1 off	Standard PPE Gloves	Nylon	0.30	kg	2.34
4 off	Safety specs	Polycarbonate	0.10	kg	0.97
1 off	Roll of emery paper	Paper	0.01	kg	0.01
4 off	25mtr Extension hoses - air	Reusable	40.00	kg	
1 off	Cantilever Toolbox c/w Hand Tools	Reusable	12.00	kg	
4 off	Hammers (range)	Reusable	40.00	kg	
1 off	Spanner Set	Reusable	6.00	kg	
1 off	Pry Bar Set	Reusable	10.00	kg	
2 off	Paint scrapers	Reusable	8.00	kg	
2 off	Metal Buckets	Reusable	4.00	kg	
1 off	Brush pan & shovel	Reusable	5.00	kg	
1 off	QF tooling	Reusable	200.00	kg	
1 off	Pipe cutter	Reusable	22.70	kg	

Calculation Data – Traditional Replace

Qty	Description	Description	Value	Unit	kg CO_2e
1 off	Fabricated spool piece with flanges	Carbon Steel	81.50	kg	222.30
6 off	Tig gloves	Carbon Steel	26.00	kg	122.40
6 off	Welder's glove	Textile Towelling	4.00	kg	102.00
2 off	Standard Flanges	Disposable Gloves	0.50	kg	92.08
5 tubes	Weld consumables - Filarc PZ6513	Energy consumption 80 watts / hour	15.34	kWh	50.46
1 off	Box of rags	Nylon	0.30	kg	45.47
1 off	Argon Cylinder	Polycarbonate	0.10	kg	24.47
2 off	TIG plant	Paper	0.01	kg	19.36
10 off	5" grinding discs	Reusable	40.00	kg	13.87
1 off	Roll fire blanket	Reusable	12.00	kg	12.36
1 off	Pressurised Habitat*	Reusable	40.00	kg	10.19
1 off	Disposable Gloves	Reusable	6.00	kg	4.79

Calculation Data – Traditional Replace (continued)

Qty	Description	Description	Value	Unit	kg CO_2e
1 off	Temporary lighting	Reusable	10.00	kg	3.26
1 off	Standard PPE Gloves	Reusable	8.00	kg	2.34
4 off	Goggles	Reusable	4.00	kg	2.19
4 off	Safety specs	Reusable	5.00	kg	0.97
2 off	Air movers	Reusable	200.00	kg	0.56
5 off	5" Wire wheels	Reusable	22.70	kg	0.44
5 off	Tungstens				0.35
5 off	Insulators				0.26
5 off	Ceramics				0.26
5 off	Collets				0.12
2 off	Inspection Lights 110V				0.10
5 off	Collet bodies				0.07
1 off	Roll of emery paper				0.01
1 off	50 KVA Heat Treatment Plant C/W power cable, Elements, pigtails & cables				
2 off	TIG plant c/w torch, cables regulator, flowmeter, hose.				
2 off	25m 440V extension cables				
4 off	25mtr Extension hoses - air				
1 off	Off-shore Gas Rack				
2 off	Grinder (Corded) - 5"				
1 off	Internal Grinder (Corded) / including spanners / keys				
1 off	Splitters 110V				
3 off	Electric Extension 110V				
1 off	Electric Adaptor 110V				
1 off	Cantilever Toolbox c/w Hand Tools				
4 off	Hammers (range)				
1 off	Digital Thermometer				
1 off	Spanner Set				
1 off	Pry Bar Set				
2 off	Paint scrapers				
2 off	Metal Buckets				
1 off	Brush pan & shovel				
1 off	Lot Tig Spares				
4 off	Grinding Visor & Screen				
6 off	Mechy Impact gloves				
1 off	Argon Gauge				

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