Marine SCR
– Cost benefit analysis

A first order economic analysis of Selective Catalytic Reduction (SCR) on board vessels has been carried out by the International Association for Catalytic Control of Ship Emissions to Air (IACCSEA). This document offers an overview of the output.

A calculation tool has been developed to grant some insight into the costs and benefits of installing and operating SCR technology on-board shipping vessels, in order to meet IMO Tier III NOx limits. The major costs of SCR will depend on engine operation and on the time spent in an Emission Control Area (NECA). Fixed costs include initial capital and installation costs for the equipment. The major operational costs are those of the reducing agent (e.g. urea). The calculation tool recognises that any fuel penalties which arise due to pressure drop across the SCR system are offset because a fuel optimised engine with an SCR system allows for a fuel efficiency benefit. In other words - fuel savings can dramatically reduce the cost of SCR technology. It is worth noting that the model incorporates some scaling down of costs over the lifetime of the vessel, as it assumes economies of scale.

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SCR costs derived from the model:

1) 10MW engine, powering a vessel of 20,000 DWT that spends 1500 hours p.a. in a NECA

- The capital expenditure cost (including system installation) will be of the order of **$500k.**
- The largest operational costs (AUS40 urea) required to meet IMO III (from an IMO I baseline NOx level) would be of the order of **$950k** over the 25 year lifetime of the vessel.
- During the vessel lifetime of 25 years the catalyst recharge cost will be of the order of **$450k** and the system maintenance cost some **$150k.**
- Whilst a fuel penalty due to back pressure caused by the SCR equipment may be of the order of **$175k,** an efficiency gain of 2% could lead to fuel savings of the order of **$425k.**
- All this considered means a total SCR cost of some **$2.25m** and a benefit of **$425k.**
- This equates to a total cost of ownership of the order of **$1.8m** over the lifetime of the vessel, or about **$75k** p.a.

2) 10MW engine, powering a vessel of 20,000 DWT that spends 8000 hours p.a. (the whole year) in a NECA

- The capital expenditure cost (including system installation) will be of the order of **$500k.**
- The largest operational costs (AUS40 urea) required to meet IMO III (from an IMO I baseline NOx level) would be of the order of **$4.95m** over the 25 year lifetime of the vessel.
- During the vessel lifetime of 25 years the catalyst recharge cost will be of the order of **$1.05m** and the system maintenance cost some **$150k.**
- Whilst a fuel penalty due to back pressure caused by the SCR equipment may be of the order of **$900k,** an efficiency gain of 2% could lead to fuel savings of the order of **$2.25m.**
- All this considered means a total SCR cost of some **$7.55m** and a benefit of **$2.25m**
- This equates to a total cost of ownership of the order of **$5.3m** over the lifetime of the vessel, or about **$225k** p.a.

A brief breakdown of the above calculations is provided overleaf.

Capital Cost of the SCR System

The capital cost of SCR technology is mainly a function of the engine power.

Installation Cost

Installation costs are again a function of the engine power, though much lower for new build installation over so-called retrofit. IMO Tier III regulations on NO_X apply to new build vessels, where the Tier III technology solution is incorporated early on in the design phase. Though installation costs are initially high – up to twice the Capital Cost of the SCR equipment, this cost will have a significant learning curve which could bring this cost down in the future.

Maintenance Cost

A maintenance cost of 3% of capital cost is assumed.

Operating Costs

Operating costs are a function of the time spent in a NO_X ECA. The major operating cost is that of the reducing agent, Urea AUS40. The cost of replacement catalyst and the fuel penalty due to back pressure exerted by the SCR system can also be considered as operating costs.

A) Urea

This is the major operating cost and is a function of the required NO_X reduction and is heavily dependent on the time spent in the NO_X ECA.

B) Catalyst Replacement

Catalyst performance decays slowly with time. Generally the mechanism of this performance drop is well understood allowing manufacturers to offer guarantee periods. With cleaner fuel, catalyst performance is maintained for longer. Guarantee periods are typically 16,000 operating hours.

C) Back Pressure Penalty

A small back pressure penalty is also considered.

Fuel Efficiency

One benefit of SCR technology is the fact that engine/SCR systems can be fuel optimised. Up to 7% efficiency could potentially be achieved in certain circumstances, though a figure of 2% may be more typical. The calculation tool allows an operator to observe the impact of increased fuel efficiency (accompanied by higher NO_X formation in the engine) on the total cost of operation.

Other Costs

Other costs include certification and classification costs. These costs may be significant to begin with but will depreciate quickly with experience and will become a very small addition to the administration costs, e.g. of certifying the engine.