The Oil Drum: Australia & New Zealand
DISCUSSIONS ABOUT ENERGY AND OUR FUTURE

The Cost of Corrosion

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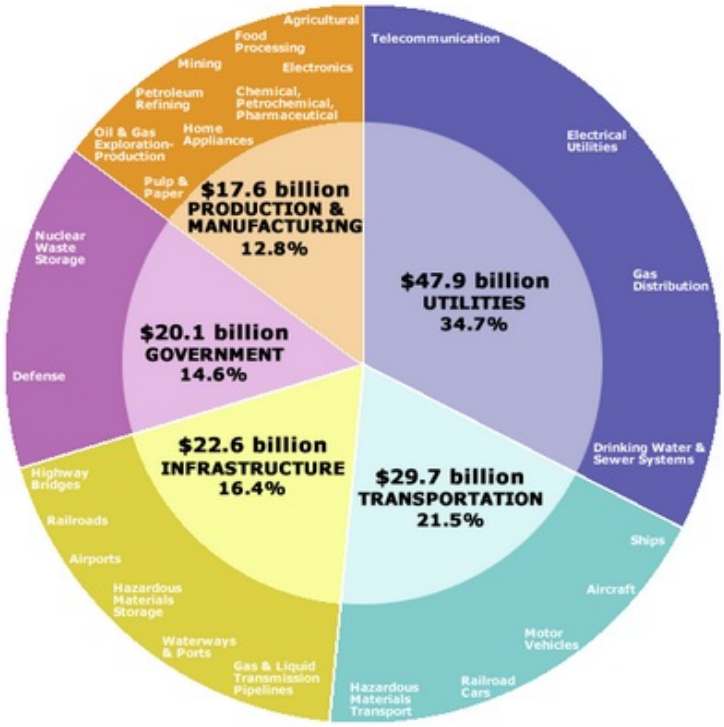
Topic: Supply/Production
Tags: corrosion, infrastructure [list all tags]

Corrosion engineers are not always popular in the oil and gas industry as they are usually requesting money for additional maintenance, or to take something offline for inspection or have something else shut down if it has really deteriorated. But ageing infrastructure (as well as an ageing workforce) is one important aspect of the peak oil problem.

There have been several attempts to put numbers to this problem, most notably by NACE (formerly the National Association of Corrosion Engineers). Their major study on 'The Cost of Corrosion' was published in 2002, but based primarily on 1998 data.

1998 Cost of Corrosion: $276 billion per year in USA across all industries

- $48 billion for utilities
- $23 billion for infrastructure
- $30 billion for transportation



The following elements were included in these costs:

- Cost of additional or more expensive material used to prevent corrosion damage.
- Cost of labor attributed to corrosion management activities.
- Cost of the equipment required because of corrosion-related activities.
- Loss of revenue due to disruption in supply of product.
- Cost of loss of reliability.
- Cost of lost capital due to corrosion deterioration.

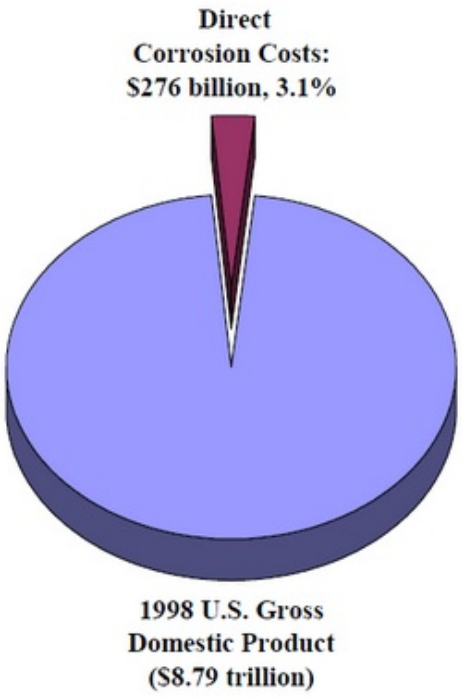
Gas & Liquid Transmission Pipelines

From the study on the NACE website:

> There are over 528,000 km (328,000 mi) of natural gas transmission and gathering pipelines, 119,000 km (74,000 mi) of crude oil transmission and gathering pipelines, and 132,000 km (82,000 mi) of hazardous liquid transmission pipelines. For all natural gas pipeline companies, the total investment in 1998 was $63.1 billion, from which total revenue of $13.6 billion was generated. For liquid pipeline companies, the investment was $30.2 billion, from which revenue of $6.9 billion was generated. **At an estimated replacement cost of $643,800 per km ($1,117,000 per mi), the asset replacement value of the transmission pipeline system in the United States is $541 billion; therefore a significant investment is at risk with corrosion being the primary factor in controlling the life of the asset**. The average annual corrosion-related cost is estimated at $7.0 billion, which can be divided into the cost of capital (38 percent), operation and maintenance (52 percent), and failures (10 percent).
>
> Significant maintenance costs for pipeline operation is associated with corrosion control and integrity management. The driving force for maintenance expenditures is to preserve the asset of the pipeline and to ensure safe operation without failures that may jeopardize public safety, result in product loss, or cause property and environmental

> damage. The majority of general maintenance is associated with monitoring and repairing problems, whereas integrity management focuses on condition assessment, corrosion mitigation, life assessment, and risk modeling. With a range of corrosion operation and maintenance cost of $3,100 to $6,200 per km ($5,000 to $10,000 per mi), the total corrosion operation and maintenance cost ranges from $2.42 billion to $4.84 billion.

Perhaps the most useful summary of the NACE study is that the cost of corrosion represented around 3% of US GDP at the time. This allows us to very roughly estimate the current cost of corrosion, ten years on.



2008 Cost of Corrosion

3% of $14.2 trillion US GDP in 2008 = $430 billion, the current cost of corrosion in the U.S, compared to $276 billion in 1998.

3% of World GDP of ~$55-60 trillion tells us that the global annual cost of corrosion is now **~1.5-2 trillion US dollars**.

It looks like others are making the same extrapolation, like Rolf Gubner at a recent Materials Australia presentation:

> **At AU$2.8 trillion, the annual cost of corrosion worldwide is over 3% of the world's GDP**. Yet, governments and industries pay little attention to corrosion except in high-risk areas like aircraft and pipelines. Now is the time for corrosion professionals to join together to educate industry, governments, and the public. Now is the time to work together to harmonize standards and practices around the world and to communicate and share corrosion mitigation technologies. We are at a unique point, when the tools and resources are all in place to match our needs and help us meet our goals.

> Now is the time to make government agencies, industry, and the public aware of the high cost of corrosion – to our environment, our resources, and humankind. Corrosion has a profound effect on the quality of life of our children and grandchildren and the inhabitability of our planet. Now is the time to make a major impact to protect the environment, preserve resources, and protect our fellow human beings.

Matt Simmons has regularly talked about the ageing workforce and ageing infrastructure in his peak oil presentations. In recent presentations, he has started putting a figure on it as well:

> **The Oil And Gas System Is Sick**
>
> - Total cost might exceed $100 trillion.
> - Manpower needs probably require millions of engineers and far more construction workers.
> - Could the world run out of iron ore and steel in getting the task done?

Renewals, upgrades and other major maintenance activities over a period of time are the norm for many major facilities, such as refineries, rather than wholesale replacement. Elsewhere, offshore oil and gas platforms in many areas will be decommisioned as they reach the end of their economic life, with several such plans under way for exhausted fields in the North Sea. But other infrastructure, including buried gas and water mains in congested city areas, can be much harder to maintain or renew. While they may last 50 or even 100 years, they can be a serious headache when they need to be replaced.

At $2 trillion per year (the earlier rough estimate for the current cost of corrosion) it would take fifty years to rebuild 100 trillion dollars of infrastructure (across all industries). Since much of our infrastructure is 20, 50 or even 100 years old, renewing it over a period of half a century seems reasonable.

On the other hand, it could be reasonably argued that the condition of our infrastructure is getting worse on average and that the rate of spending needs to increase. But there is a limit to how much a $60 trillion world economy can spend on renewing infrastructure, especially as the economy itself declines. The alternative to increasing spending is to accept that the level of service will decline and that the number of failures may increase.

Whatever the actual cost is, engineers everywhere have plenty of work ahead; managing ageing infrastructure and delivering new projects, while meeting sustainability challenges and protecting scarce resources. So I'm not too worried about my job just yet.

What do you think?