17 Reducing final demand

for metal services

If we can't find enough options to meet our emissions targets through energy or material efficiency, we need to consider the possibility of demand reduction also. Does this automatically mean impoverishment—the reverse of development—or are there other options?

A Valkyrie on a horse in park

We're approaching a heroic theme in this chapter, so who better to help us on our journey than Richard Wagner, who's defining opera cycle "The Ring of the Nibelung" was first performed as a whole at Bayreuth in 1876, 21 years after Bessemer patented his steel making process, and 10 years before Charles Hall and Paul Héroult discovered a commercially viable route to produce aluminium. It's tempting to start with the Nibelung themselves, dwarves toiling at their forges in their underground cave of Nibelheim, under the merciless supervision of their insatiably greedy boss Alberich, and we could make something of the low yield losses of their process for forming the Rhinegold into helmets and rings. But instead, we'll turn to George Bernard Shaw's commentary "The Perfect Wagnerite" in which he draws an analogy between the ending of the reign of the Gods in the Ring Cycle (in the final opera, the great palace of the Gods, "Valhalla," which was completed just before the first opera begins, burns and subsides back into the Rhine) and the collapse of Capitalism. Alberich who, at the beginning of the cycle renounces love in order to steal the Rhinegold, symbolises capitalist leaders who, in the pursuit of profit, have forgotten their higher human values. The long narrative of the cycle of four operas tracks the deceitful tricks of those who pursue wealth and power at all costs, and finally they receive their comeuppance when Valhalla—the capitalist system—burns, and the Rhinemaidens can return to their opening innocence, with the gold in its rightful place, underwater.

Heady stuff—but this is a daring chapter. We set out in this book to examine all possible options to halve carbon emissions from producing materials, within 40 years while demand for material services doubles—and having looked at all possible efficiencies in existing processes, and then looked at all possible material efficiencies, we have one apparently apocalyptic option remaining: simply living with less. We'll explore three variants of living with less: using goods more intensely, so that our total demand for material services can be met with fewer

goods; finding alternative means to provide the same services, but using less material; and reducing our overall demand for the services.

In public, no business leader and no politician or policy maker can propose an ambition of reduced profit or induced recession. But in private, after a glass of wine and a nice meal, virtually everyone we've talked to in those positions has said to us "of course, we all know we're simply consuming too much." And in developed economies we do all know that—because nearly all of us can remember consuming less a few years ago. If we read the gravestones in our local churchyard, we have yet to find one which says "Here lies John Smith, whom we remember because he owned a large pile of material". And if, from within our developed economy, we make a quick mental survey of our friends and colleagues, very few of us will be able to report that those who own most material live happier lives than those who's relationships, families, senses and imaginations are most vibrant. So, with a little inspirational help from Wagner, let us sally forth as heroes into the dark forests of demand reduction.

Providing more services with less material by more intense use

"The Ride of the Valkyrs" by John Charles Dollman

The third act of the second opera of The Ring cycle, begins with the famous "Ride of the Valkyries" during which eight Valkyrie, wild maidens whose regular line of business is the delivery of dead heroes to Valhalla, fly on winged horses to a meeting on the Valkyrie rock. The meeting will begin when eight of them have arrived, and their journey takes approximately eight minutes. The flying horses have little else to do in the whole cycle, so out of approximately 15 hours, are used for around 1% of the time. This is similar to our use of cars in the UK: typically we each spend 225 hours per year in a car, we have 28 million licensed cars in the UK with an average of 4 seats in each, and there are 60 million of us, so on average each licensed car seat is used for under 2% of the year. Do we really need eight flying horses? If the horses are strong, and the Valkyrie slender, could we mount two Valkyrie on each, and cut our requirements for flying horses to four? Alternatively, could we sequence the arrival of the Valkyrie on the Rock, starting earlier for example at the beginning of Act II during which neither flying horses nor Valkyrie are involved, and so deliver all eight of them with just one flying horse? Do we need fifty times more car seats in the UK than are, on average, in use at any time? What a fantastic material saving opportunity that suggests.

We can use products more intensively either by using more of their capacity when they're in use, or by increasing the fraction of time we use them. We've illustrated this on the graph which shows in blue a 'use profile' for a notional product, the fraction of its capacity used over time. The grey box shows the full capacity of the product over its full life so the ratio of blue to grey area is a measure of how intensely we are using it: the visible grey area shows under-utilisation. What can we do to make better use of this spare capacity? Broadly we have two options: we can make more use of the product, or we can design products with less capacity, and these options are all illustrated on the graph.

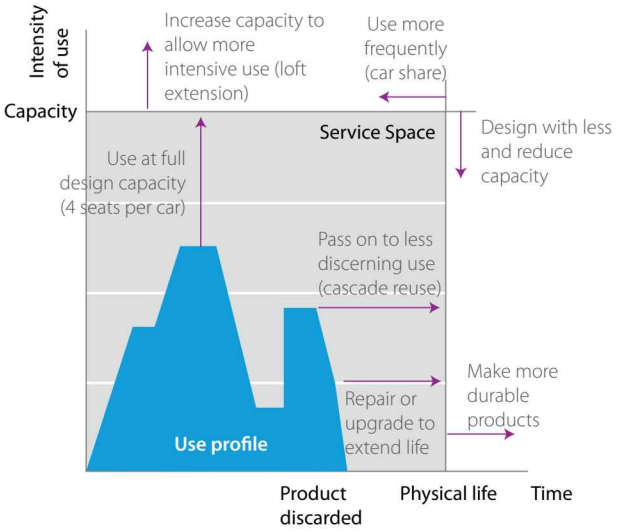


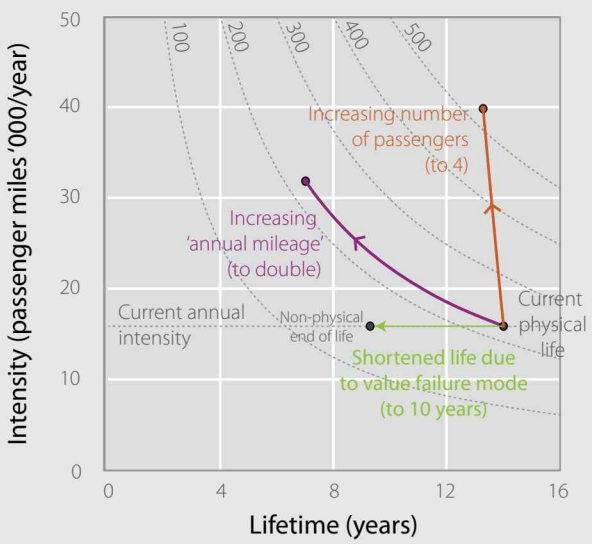
Figure 17.1—**Schematic of intensity of use**

Making more use of products is possible through using the product more frequently (to extend the blue use-profile sideways up to the physical life), and using more of its capacity, (to stretch the blue use profile upwards). The logic of public transport systems is that providing a larger capacity shared service allows more intense use of a greater fraction of capacity than if each user owns their own separate vehicle.

Designing products with reduced physical life and capacity sounds wrong after our previous chapter on life extension. However, if we are building products that will inevitably reach 'unwanted' failures, due to technical or style obsolescence for example, then as well as designing them to be recycled, we should try to match their physical life to their useful life, to avoid excess material use.

Using products more intensely will lead to material savings if increased use does not proportionately shorten their expected life. We've illustrated this in the box story on using vehicles more intensely which shows that making more use of capacity (more seats occupied) greatly increases the total service output (passenger miles) delivered by the car. However driving twice as far per year, with the same passenger load, simply shortens the life of the car without changing the total service output. We can explain this from what we learnt about the Archard equation in the last chapter: wear of the sliding surfaces in the car is proportional to both load and distance; doubling the number of miles driven per year, thus halves the time until the critical distance is reached; however doubling the passenger load has only a small effect on the total load, because the car is much heavier than its passengers.

Can we identify which products would show most benefit from more intense use? To examine this, we've created Figure 17.2 which plots our catalogue of steel and aluminium products on axes of intensity against lifespan. The contours on the plot show the equivalent time for which the products have been used at full capacity, and the radius of the data points is proportional to the fraction of total metal use. The chart shows that industrial equipment provides the highest equivalent years of service for both metals: such equipment is typically used intensively and



Using vehicles more intensively

We can see that increasing average passenger loading from 1.6 to 4 (the orange line) makes little difference to the physical life of the car (because the car weighs more than the passengers) but more than doubles service output. Doubling the annual mileage (the pink line) halves the physical life of the car but does not change the service output. This reduces the chance that a car is discarded before the end of its physical life e.g. because it is outdated. Finally reducing the average life of a vehicle from 14 years to 10 years with no change in utilization (e.g. due to an accident or as promoted, for example, by the expired UK scrappage scheme) decreases total service output by 30% (the green line).

Similarly, increased loading on trucks, trains, ships and washing machines causes a disproportionately small loss in product life, though the ratio will vary widely by product type. Offices are currently used less than a quarter of the time and could be used more frequently with no effect on building life.

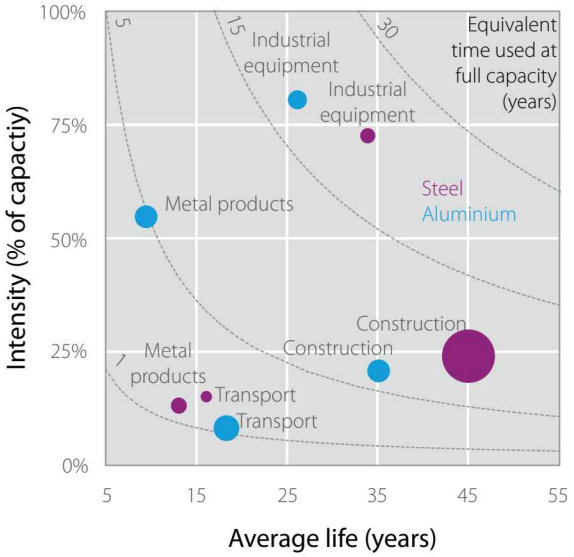


Figure 17.2—**Intensity and product life**

discarded due to severe degradation or changes in requirements. For example, electric transmission cables are in near-constant use over a 30 year lifespan, and are only discarded when they become unsuitable, typically because higher power must be transmitted.

However metal products, such as cars and domestic washing machines provide the lowest equivalent service level. Could this be improved by shared ownership? Could we use launderettes instead of owning our own washing machine, or car pools instead of our own car?

Shared ownership is related to renting, and in effect the recent growth in city bicycle share systems is a convenient form of short term renting. However, it is as yet quite difficult to set up such systems effectively. A study of a car pool system in Austria found that simply looking at the costs of each driven journey showed that around 70% of all households would save money by using a car pool[1]. However, the reality of car use is that the car serves many functions other than the journey, for instance as a convenient place to wait to meet someone, for storage, or as an indicator of prestige and so on, and with these factored in, only 9% of households would benefit from the car pool.

Shared ownership offers the potential for significant saving in material requirements but the real difficulty of sharing is that we associate ownership with development: part of the service provided by material goods is their instant availability and convenience. Shared ownership denies this, so requires some

increased personal discipline and as yet we have identified few instances where people find this attractive.

Finding alternative ways to deliver services, using less materials

Discussing productions of The Ring always opens up opportunities for subversive humour, so we'll avoid the temptation to discuss having the Valkyrie arrive on skateboards, to save on the flying horse budget. Instead, let's explore a truly awful heresy. It's extremely expensive to put on a production of The Ring: apart from 24 lead soloists, seven other Valkyries, a chorus of Niebelungs and Gibichungs and an orchestra of a hundred, we also need, say, a hundred other backstage, front of house, production and marketing staff. If each of these people are involved in two weeks of rehearsals, and four full performances of The Ring (16 nights spread over three weeks) and are paid an average UK wage of £430 per week, the cost of the production is £540,000 before we rent a venue or pay for the advertisements, or offer incentives to our star singers. So double the total, and divide by 1000 seats and four rounds of the cycle, and your average ticket price is around £270 per person to see the entire Ring.

Bikes belonging to the cycle share scheme in London

So now the heresy: given the rise of computer technology, sound sampling, video games, and animation, maybe we don't need any people or the venue! Instead, armed with the latest Kinect sensor on our Xbox, we could conduct the whole Ring Cycle ourselves, while our friends come round to act out the leading roles, and direct the performance. We only need one copy of the score to scan into a good sound system, and we can create the whole piece—music, staging, lights and more, in our own front room, and not one artist required!

An awful heresy indeed, and although it's close to what's currently possible, it will be years (and we hope never) before simulated performances can really replace live ones. But more broadly, can metal services be delivered without the metal?

The most striking opportunity to avoid using metal is to use video-conferencing to avoid business travel. We can't imagine finding a non-material substitute for construction, equipment or most metal goods, but many of us would actively like to avoid business travel: why has video-conferencing not developed? Although there is no global data on the substitution between video-conferencing and air travel, national, survey-based studies show that the substitution rate is low, with

video-conferencing competing for just 1–3% of the business travel market[2]. Video-conferencing has had some success in certain industries (e.g. banking, insurance, IT, oil and the chemical industry), especially to substitute for travel to internal meetings (which account for just 10% of business travel) but has failed to compete with business air travel more widely. The main reason for this appears to be that, despite more sophisticated video-conferencing packages, they cannot compete with face-to-face meetings for developing relationships so are not a viable substitute for negotiations and marketing demonstrations[3].

Substituting virtual for physical services has been much discussed, particularly with developments in the internet. The reality has been different, paper use is still growing, despite opportunities to use less paper by substituting electronic information storage as we'll see in chapter 22. Within the world of steel and aluminium, we have found very few opportunities to avoid metal use by providing a service in a different way.

Reducing our total demand for material services

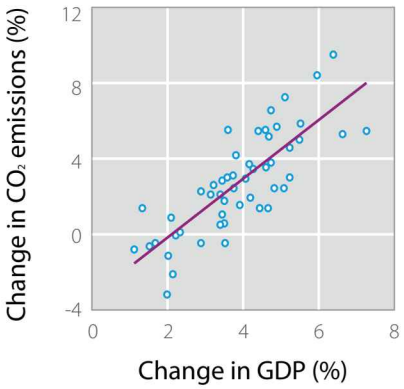


Figure 17.3—**The relationship between emissions and GDP**

On to the fourth opera in The Ring cycle, "The Twilight of the Gods", and after everyone who has owned the Ring has died, Valhalla falls, the unhealthy era of the Gods ends, a new era of human love is promised, and the Rhine is once more at peace. Or, within the analogy with which we opened, the ruthless pursuit of wealth and power has destroyed itself, and a collective view of well-being been re-launched.

Is it right? If we step away from wealth to other measures of well-being, would we save metal, and would we be better off? To ensure that we can reach our target of a 50% emissions cut while demand doubles, we need a fallback option: to reduce demand. This will never be a part of corporate strategy, and is unlikely to be prominent in public policy, at least partly because economic growth as we understand it at present is fuelled by borrowed money (debt) and the only way to pay back the debt is to grow. Yet, over the past century, recession has been a reliable predictor of emissions abatement[4]. Figure 17.3 shows how changes in the UK's GDP correlate closely with changes in our annual emissions of CO_2. Recession, or at least avoiding future growth, would constrain our demand for energy and materials, and therefore lead to reduced emissions. For fun, in his retirement speech from the University of Surrey, Professor Roland Clift suggested that a low-carbon lifestyle would involve spending our spare money on stone

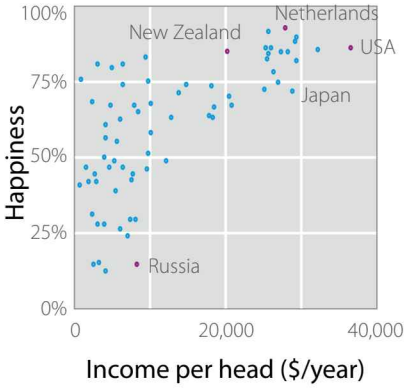


Figure 17.4—**The relationship between GDP and happiness**

sculptures: which have low embodied energy but higher labour costs. But can we imagine whole nations ever wanting to pursue recession?

Surprisingly, the answer is yes, and a rapidly growing area of behavioural economics is examining what sounds like the un-definable topic of "happiness". We can create a defensible index of happiness for a country, because whatever measures we use seem to be well correlated. We might measure mental health statistics, self-assessment, divorce rates, drug abuse and many other measures of social wellbeing and they largely support each other, so various economists have created aggregated measures of national happiness. Once you have this index, the obvious first question is "are richer countries happier" and this is explored in Figure 17.4. The graph gives a clear message, which we've seen recreated using several different happiness measures: up to a national income around $15,000 per person, countries become significantly happier as basic needs for health, nutrition, shelter and security are met. Beyond that threshold, further increases in happiness rise slowly, if at all.

We've come a long way away from our core subject and need to refer you to other sources if this topic catches your interest (as it does ours)[5]. But the story of this section is that if to meet our emissions reduction target, we chose to reduce our demand for materials, we might well not be any less happy than we are now. It's very difficult to see governments or businesses pursuing that as a target, but it provides a rational basis for a social movement, when we compile our forecasts, and we need to retain it as our 'option of last resort' to guarantee that we can meet our overall emissions reduction target.

Outlook

In a war, natural emergency or other crisis, populations rapidly adjust to different patterns of behaviour, including reduced expectations about reasonable levels of demand. However this is largely induced by shortage of supply, so is accepted because there isn't a choice. In this chapter we've found two options to reduce demand for metal which could be acceptable before a crisis: through increased intensity of use and through service substitution. And we've found one option which depends on a major social change: through choosing well-being over wealth.

There is a time-delay between the actions that cause environmental harm and the harm appearing. Do we have any evidence that populations voluntarily choose demand reduction to cause less harm, before a crisis arises? Positively we can look at the wonderful range of both religious and secular charities through which the wealthy limit their own spending in order to contribute to development. Negatively, we can reflect in astonishment at the population of Easter Island (A.D. 900–1700) who caused their own demise by chopping down all the trees on their island[6]. What could possibly cause a population to undermine itself in this way? Maybe they were burning the trees to keep themselves warm? Or building shelters to keep themselves dry? No, their fatal vice was none other than building stone statues! It seems that the population of Easter Island were early pioneers of Roland Clift's carbon abatement strategy. So intense was their competition over stone statues (evident from the increase in statue size and their more elaborate designs) that it caused the demise of their civilisation. Two things are clear from this story: that mankind's competitive nature is inherent, and that we must continue to search for a low emitting, sustainable outlet for this behaviour.

And having raised our option of last resort, demand reduction, we're now ready to return to our adding up process, to find out whether we have enough options to reach our target, before we have to throw the Ring back in the Rhine.

Notes

Providing more services with less material by more intense use

1. This study was conducted by Prettenthaler and Steininger (1999).

Finding alternative ways to deliver services, using less materials

2. Denstadli (2004) finds that the substitution rate for Norway is 2-3%, obviating 150,000-200,000 trips 1998-2005; Roy & Filiatrault (1998) find a substitution rate of 1.8% for Canada.

3. Based on a survey of the Taiwanese technology industry Lu & Peeta (2009) show that video-conferencing is often adequate for information exchange, management meetings and training, but not for the face-to-face meetings required for negotiations and marketing demonstrations.

Reducing our total demand for material services

4. Bowen et al. (2009) explore the relationship between carbon dioxide emissions and GDP with a view to predicting the likely emissions impact of the 2008 financial crisis. They find that there are two effects on energy demand in recession: (1) demand for output falls and as a result demand for energy to produce that output declines, (2) if energy prices fall, firms may substitute energy for other inputs to production. They forecast that UK emissions will be up to 9% lower in 2012 than they would have been without the recession.

5. Layard (2005) gives an introduction to the field of happiness economics.

Outlook

6. The story of Easter Island is documented in Jared Diamond's book (Diamond, 2005) Collapse. The trees were used to make wooden platforms and rope for dragging the stones to location and leveraging them into position. The intense use of trees for these purposes coupled with a plague of rats that ate seeds, severely diminished tree stocks. The inhabitants of Easter Island prioritised statue building over building sea canoes, limiting their diet to small land mammals and birds and undermining the sustainability of these animal populations. The loss of animals that acted as pollinators and seed dispersers ultimately caused the end of the forest as well as the island's food stock.