6 Green Operations

Online student resources

Additional materials

Smart grids

Traditionally, national electricity grids have been built as uni-directional infrastructure designed to carry electricity from the site where power is being generated to users' premises. This basic approach has certain shortcomings, however. Firstly, due to great variability in the demand for electricity at certain times of the day, week or even year, grids have generally had to be over-sized in terms of their average transmission requirements, a surcapacity that is very costly and wasteful in financial but also energy terms. Secondly, up until now most grids have lacked feedback mechanisms allowing operators to track system output, meaning that management of power flows and outages has been less than optimal. Thirdly, the scale logic applied to most power plants today means that electricity tends to be generated on a few, large central sites - lengthening the distances over which it has to be distributed to reach end users, an organisation that itself consumes (and wastes) a great deal of energy. Lastly, the rise of smaller scale, decentralised renewable power generation necessitates two-way flows, not only from central sources outwards as is currently the case but also from peripheral sources back towards the centre or even towards other peripheral 'islands' that can be very dispersed due to a territory's uneven endowment in the natural resources (Monbiot 2007). This multi-directional distribution capacity is largely lacking in traditional grids – explaining, alongside these other factors, why so much attention has been devoted in recent years on developing a new alternative called 'smart grids'.

This concept has become a major green business ambition for utilities but also for computer companies seeking to provide the intelligence required to manage the new systems. The stakes are enormous given skyrocketing global demand for new electricity provision, with demand in the US alone expected to rise by 30 percent to 5,400 terawatts per annnum by the year 2030 (Bruno 2009). Viewed in this light, it is not as much a question of whether utilities can afford to adopt a more efficient grid technology but rather whether they can afford not to. It is doubtful that the sector will be able to satisfy the expected increase in global demand in the absence of technological transformation. Without the change, users face a bleak future of recurring outages and rationing. Certainly, this is the judgement of more and more governments worldwide, with for instance as much as 13 percent of the stimulus package that the Obama Administration put together in the wake of the 2008 credit crunch being allocated to building smart grids. Whether this suffices is another question altogether. It has been estimated that upwards of $800 billion in total will be required to modernise the North American grid alone. This can only be achieved if a whole array of stakeholders – "**geeks, politicians, regulators, entrepreneurs' and consumers" (**Budiardjo 2010) become fully involved in the process.

Such collaboration is particularly apt given the key role played in smart grids by interactive communications between the system as a whole and dispersed local "utensils" such as smart meters that can be used to quantify and ultimately modify end user behaviour (Steffen 2009). The basic precept in the new approach is that users' electricity-consuming appliances will be able to exchange information with smart meters that can in turn communicate with one another and/or with the grid's central power sources. The goal is to implement something approximating the just-in-time logic characterising certain modern industrial systems, where better knowledge of inputs' real consumption patterns - in timing and volume terms – enables enormous savings by alleviating the need for buffer stocks and/or productive surcapacities. There is also the expected impact of micro-generation, in the sense of the grid being able to upload surplus power either created locally by renewables technologies (solar panels, wind turbines) or currently lying dormant while awaiting future use (energy stored in electric vehicles, appliances, etc). A two-way smart grid would be able to access these dispersed energy pools and extract greater value from them than if they remained in storage under suboptimal conditions for long periods of time. This flexible approach can be equated with the current practice of 'peak shaving', which is when utilities install small supplementary capacities that are fired up to satisfy peak demand, thereby alleviating the need for costly surcapacities. In general, anything that evens out the variability in system usage is highly beneficial, explaining an array of suggestions for incentives to modify consumer behaviour through adapted charging systems, much like telephone companies charge more for calls made during the day than at night. This will only work if consumers become more aware of their real usage patterns, yet another justification for the mass rollout of intelligence devices (i.e. Google's Power Meter software).

The question then becomes how to shift from the current system to the new configuration. The key at this level is identifying superior smart grid technology, standardising this and educating consumers as to its advantages

(Gilligan 2010). Some of the bigger names in this field are working specifically on enabling this transition, one example being the American giant GE, whose Ecomagination division (see Chapter 7) is turning out a host of products serving this purpose, ranging from the gridSMART demonstration project that it has developed in conjunction with AEP to the GE WattStation that reduces electric vehicle charging times, bringing closer the day when automobiles will become fully-fledged participants in national grids (Guevarra 2010). Along these lines, traffic control - in the form of traffic light coordination reflecting commuting patterns - was one of the first areas where smart grids were being experimented with by companies everywhere, led by household names such as IBM and Siemens (c.f. http://www.smartgridtour.com/). What is interesting is the high level of cooperation in this areas between companies that would normally be fierce rivals. All of the aforementioned names participate in Institute of Electrical and Electronics Engineers (IEEE) standards efforts to ensure interoperability and a better integration of sensors, real-time databases and self-healing functions. The technology is too new, too global and too important to turn its back on the possibilities provided by cross-industry collaboration (Budiardjo 2010). The vision of a grid where all electricity-consuming and producing devices worldwide connect with one another is so exhilarating and daunting that companies feel obliged to develop it in partnership.

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■ Recyclate markets

Above and beyond the pollution and resource depletion arguments considered throughout this book, there is the issue of how reusable different kinds of waste are in and of themselves. This question is not unrelated to the various factors affecting the choice of a primary material to be used during a particular transformation process – starting with the substance's strength and durability (Richards and Frosch 1997) – although the analytical focus does shift when recyclates are under scrutiny, given the way in which certain materials' chemical and structural properties deteriorate when they are reprocessed at the end of their initial life. Hence the need to distinguish in recyclate markets between inchoate materials serving as generic components (i.e. paper, glass, plastic) and manufactured components or modules that can be reclaimed in their current state and sold in secondary markets (i.e. as refurbishable auto parts or reusable circuit boards). Because the latter can be reused more readily, they clearly offer greater value than the former, which explains ongoing efforts in many industries – as well as governmental recycling directives - to ensure that products are designed from the very outset along 'modular' lines way specifically so that they can be recycled and reused in their current state without having to undergo any reprocessing at all. This is part of the 'separate metabolism' approach that W. McDonough advocates in his 'cradle-to-cradle' schema that Chapter 6 reviews. It includes chemical evaluations aimed at ensuring that hazardous materials are not being used in products and "identifying potential chemical-related problems early enough in design so that the product and process used for manufacture can be re-engineered" (Bardelline 2009) This is crucial due to the embedded toxins found in many products entering the waste stream. For instance, the 112,000 computer boxes alone that are discarded daily in the United States contain a broad range of substances – "lead, cadmium, brominated flame retardant, phosphorus, barium, dioxin, mercury beryllium, hexavalent chromium and polyvinyl chloride"– that require special handling before recycling can even be considered. As experts warn nowadays, to even have a hope of organising a recyclate market, it is crucial to "know what is in your trash" (Friend 2009).

The same quality approach is also being increasingly applied to the inchoate intermediary goods that do require reprocessing before reuse. Recyclate stock that is pure has greater value because it is easier to reprocess and reuse. Conversely, when the aggregates in question have been 'commingled' (mixed), their quality is lower and they become less attractive. This partially explains why less than half the paper purchased in the world is currently being recycled (Harvey2009). The only time where it is clearly worth recycling commingled materials occurs when the items in question are very valuable – one example being the gold that German recyclers extract from the 24 million mobile phones (and millions of computers) that their country discards every year. These stocks feed a precious metals refinery operated by Nordeutsche Affineria in Hamburg, one of the world's few precious metal recyling firms. Global totals for this kind of activity are impressive, amounting to 3.5 tons of gold per annum. Given forecasts of strong commodity price rises in the years to come, it is no surprise that many of the world's leading electronics makers (including Philips, Nokia and Motorola) have started to design their products specifically so that valuable inputs of this sort can be recycled more easily (van Loon 2009).

Similarly, there is a link between manufacturers' interest in using recyclable materials and the recycling possibilities available in the locations where their goods are being consumed. Thus, in countries with a strong recycling infrastructure, there is a greater incentive to incorporate a product's potential future avatar into its initial design, only because its expected rebirth can reasonably be consiered as another potential source of revenue. In turn, this raises the question of different countries' recyclate collection capacities, and whether the infrastructure can accommodate all the stock received. Many older industrialised countries have run out of space in recent years and been forced to sell surplus recyclate stock on the global markets, often in China. In turn, this extra offer pushes down prices, which then demotivates potential recycling parties. As demonstrated by the chart below, the market for recyclates remains volatile. Its evolution is further complicated by the effects of extraneous factors such as recessions and technological shifts leading to the replacement of one type of material by another. (Greenbiz 2009)

	2004-08 avg.	Feb. 2009	July 2009	Aug. 2010
Plastic bottles (PET)	156	70	266	233
Mixed Glass	16	18	24	18
Mixed papers	41	24	39	66
Cans	82	25	?	110

Table: 6.1: Global recycling volumes by categories of stocks (in million tonnes). 2004-2008 average/ Feb. 2009 (Harvey 2009); July 2009/Aug.2010 (www.wrap.org.uk)

Finally, it is worth mentioning one industry that has made the most progress in recyclate terms: e-waste, involving the processing of computers, printers, televisions and other electronic devices whose initial avatar has come to the end of its useful life. The best information in this area comes from the EPEAT Electronic Product Environmental Assessment Tool rankings administered by the Green Electronics Council (www.epeat.net/).The volumes of outdated electronics being taken back and recycled has risen markedly since EPEAT developed its certification levels, thereby motivating manufacturers to design products in a way that reduces their end-of-life impacts. Eight leading companies — Dell, Fujitsu, HP, IBM, Lenovo, Samsung, Sony and Toshiba — "have been reporting in clear and relatively consistent ways their recycling data for at least the last five years, and some for much longer" (Greenbiz 2010). It is true that EPEAT reporting performance is less impressive outside of this leading group. But there is no doubt that this kind of approach enhances knowledge about – hence interest in – recyclate revenue streams. The end effect is likely to be industrial value chains comprised of such novel clusters as 'regional waste exchanges' or 'eco-industrial parks'. The integration of recyclates into initial product markets will leave an indelible impression on the industrial landscape.

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Revision tips

- Physical operations are often viewed as the best hope for green progress, since clean technology can enable internal improvements while positioning a company in growth markets. To prepare this transition, however, a new mental model is needed, one based less on the flows of goods and more on the delivery of functionalities. Future green business will be more service-oriented and less inclined to take physicality for granted. Planned obsolescence will disappear.
- The eco-efficiencycredo of achieving more with less has been around for a long time. The idea is that sustainability must be wired into an activity from the design phase onwards. Instead of imposing brute physical processes to achieve an output, the starting point should be working within the limitations of whatever inputs are used. This focus includes operational principles such as biomorphism/biomimicry, 'cradle-to-cradle' thinking (dividing goods into 'technical' and 'biological' nutrients), lightweighting, disassembly, lifecycle costing ,etc.
- Information technology (IT) is also key to corporate greening, due to enhanced knowledge of material flows and the potential for a just-in-time use of resources (i.e. via smart grids). IT centres have also become increasingly important energy users and can reduce their own footprint through technological progress, 'cloud computing' etc. Note the increasing 'dematerialisation' of the workplace.
- There is a need for a more holistic view of value chain functions applying 'industrial ecology' principles in which one operation's output (including waste) become another operation's input. The goal here is to imitate forests and minimise net demand for new resources. This requires great cooperation between value chain partners, often working in clusters. So far, the greatest supply chain focus has been on logistics, followed by sourcing/manufacturing strategies, with less attention having been paid to product design and 'reverse logistics' functions.
- Identifying inputs' footprint is difficult. Prime contractors can force or induce suppliers to provide information and alter behaviour (fewer toxins,

less packaging, etc.) via EPP Environmentally Preferable Purchasing specifications.

- At the upstream manufacturing level, greening efforts centre around premises management and actual industrial processes. This is not dissimilar to quality orientation's 'lean management' paradigm. At a downstream distribution level, efforts revolve around packaging (quantity and quality of materials used) and logistics (distances, fleet eco-efficiency, organisation of recyclates market).

Case Study: IBM enters the 21st century

The rise of computing in the 1980s has often been described as a third industrial revolution that differed from its predecessors because of its intangible aspects. Unlike the first industrial revolution following the invention of the steam engine the 1725 or the second one associated with the advances in transportation during the 1800s, information technology (IT) was supposed to help firms operate on a virtual plane free from any physical constraints. This was the widely trumpeted vision of a post-industrial society driven by a thriving knowledge economy and service sector. Operations associated with primary goods (raw materials) or secondary activities (manufacturing) were supposed to be facilitated due to technological progress - or else relocated to distant sites and more or less forgotten. The idea spread that companies like Nike or Dell were acting optimally whenever they outsourced functions, abandoning old-fashioned physical 'bricks and mortars' and becoming 'hollow' corporations. Academics like Zygmunt Bauman spoke of the "end of geography". Never had the natural world seemed so irrelevant as it did at the end of the 20th century.

Yet by 2007, this vision had largely faded. Skyrocketing prices for commodities (energy, factory inputs or foodstuffs) and above all the spectre of future shortages made it clear to many managers that corporate operations are necessarily dependent on physical realities. Faith in the virtual business model started to disappear given the very real possibility that the electricity needed to run companies' energy-hungry data centres might have to be rationed within a few short decades.

Yet others began to view IT less as a problem and more as a solution. One company hoping to find a new role in the gap between virtual and physical worlds was IBM, an emblematic pioneer in the computer spent. Since its birth, the company had incarnated economic efficiency, exemplified by the big mainframe computers that it was building during the mid-20th-century to help streamline corporate accounting and information functions, and also by the personal computer segment that it (alongside Apple) helped to create in the 1980s. By the 1990s, however, IBM had fallen behind Microsoft or Google, dynamic new rivals whose competencies revolved more around software development and, specifically, Internet protocols.

IBM was therefore in need of an entirely new strategy at the start of the millennium. It started out by focusing on the potential benefits associated with globalisation, but this was more of a cost-cutting exercise than anything else. Then, around 2006-2007, a light bulb seemed to switch on in the head of this venerable giant and its CEO, Sam Palmisano. The ecological imperative was becoming increasingly apparent to more and more companies who began to convert this into a core value in their mission statements. Yet few if any of these green pioneers were in the computer sector. By becoming the first IT company to redefine its main mission in sustainability terms, IBM was and is hoping to rejuvenate its brand. This could turn what was rapidly becoming a major headache for many other companies into a positive opportunity.

The new programme, ultimately launched in 2009 under the name of "Smarter Planet", is described on IBM's website as an attempt to infuse intelligence into the infrastructure that enables the development, manufacturing and sale of physical goods and services, and/or the transportation of people, commodities and power. Starting with the observation that the world is becoming more instrumented, interconnected, intelligent and interlinked, Sam Palmisano wants to mobilise IBM's vast technological competencies in a way that will allow his company to process and analyse all kinds of data in real-time while providing customers with solutions that maximise operational efficiency. Vastly different sectors are being targeted in this new effort, ranging from consumer goods to banking, healthcare, electronics or automobiles. The underlying concept is that companies that can harness information in a way that will help them to streamline operations will achieve a competitive advantage that is relevant to today's main international business challenges. In turn, these companies should be happy to remunerate service providers – such as IBM – for helping them to problem-solve.

Nowadays, many if not most IBM advertisements highlight the company's consultancy capabilities in directly or indirectly environmentally-oriented fields such as enterprise resource planning, product lifecycle management and supply chain management. The kinds of systems that IBM now pushes include an Energy and Environment Framework, where it advises customers how to reduce their carbon emissions (crucial to cost control if carbon pricing becomes standard); a Sustainable Supplier Information Management Consulting service that helps customers to cut costs by monitoring "inefficiencies and inconsistent practices [that] can cause excessive use of energy, water and materials, increased environmental impact, variances in quality, product safety concerns, and poor labour practices throughout the supply chain"; and a few mega-products such as urban congestion software for traffic authories and above all smart grids targeting big utilities.

IBM seems confident that these resource utilisation packages will be an appropriate way of linking its traditional skills to managers' growing need for environmental intelligence. The idea is that advising on green operations is a new speciality that should give the company a fighting chance of returning to a position of pre-eminence in the sector that it once helped to create. Yet there is a question whether potential customers are more likely to be interested in paying IBM for enhancement packages bolted on to existing structures or if they might prefer engaging dedicated green consultancies to completely reconfigure their operations. Even managers who do recognise the ecological imperative vary greatly in terms of their preference for revolutionary or incremental change. Between an absolute lack of sustainability and a green industrial utopia, many intermediary stages are possible.

Case study questions

A. What was wrong with the "end-of-geography" thesis associated with the rise of IT?

B. What quantum leap did IBM CEO Sam Palmisano make in 2006 in regards to his company's green strategy?

C. How did this new green business model alter IBM's operations?

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6

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