CHAPTER 1.10

How Technology Will Drive the Transition to the Low-Carbon Economy: ICT and the Sustainability Imperative

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Governments, businesses, and societies are all scrambling for a more efficient and greener way to operate and grow. Supporting this pressing need is a growing consumer population and a proliferation of myriad innovative services. Together these trends promise to usher in unprecedented business models and changes to social behavior.

It is not easy to get society to behave green unless there is an underlying support system from both businesses and governments providing a personal impetus for this change. Information and communication technologies (ICT) lends itself easily to new models of profitable services so businesses will find it lucrative to innovate in this space. The creative use of technology, coupled with innovative business models and progressive policymaking, will play a critical role in delivering the carbon dioxide (CO_2) emissions cuts needed to meet global climate change targets. ICT companies can leverage their abilities in smart information management and create new services that positively influence human behavior to combat the climate challenge, thus benefiting company, society, and government in a triple win-win-win scenario.

This chapter will explore the impact of technology, innovative business models, and policymaking on environmental sustainability.

The economic opportunity triangle: Change in life, work, and play

We are on the threshold of a huge opportunity that will unfold over the next couple of decades. Spoken in the midst of the current challenging times, a statement like that may sound preposterous, but three distinct trends have emerged over the past few years, and we must not let the recession cloud their visibility.

The first trend is the likely addition of a huge number of consumers to the global marketplace. There are various estimates about the numbers; the top end of the estimates is upward of a billion over the next decade. These consumers will come mostly from the developing countries. As education, infrastructure, and healthcare progress in these countries, a vast number of people will take advantage of these improvements for better living standards. All of them will need shelter, food, transportation, communication, education, healthcare, entertainment, appliances, and a lot more. The infrastructure in their countries should also be developed to support the aspirations of these people. This trend provides a huge opportunity for companies in various industries, particularly in the ICT sector.

If we look at the composition of various segments of global output, we see that the services sector contributes significantly to the global economy. This is where the second trend manifests itself. The continuous addition of new consumers to the market has prompted the creation of more and new services and the modification of old services to cater to their needs and preferences. The

whole spectrum of sectors, ranging from insurance and retail to transportation and communication, has to constantly innovate and fine-tune its services. An example is the way in which mobile telephony services have grown exponentially over the past decade. Modern ICT is making computers, as we once knew them, disappear into objects. People, systems, and objects are beginning to collaborate in unforeseen ways as mobile connectivity becomes more and more ubiquitous. There are more mobile phones in the world today than there are cars, and the possibilities of services that can be delivered through a mobile phone have increased many fold. Industry sectors such as airlines, logistics, banking, insurance, and news agencies, to name only a few, have begun delivering a wide gamut of value-added services through mobile phones.

Collaboration is one of the biggest pillars of innovation in recent times. ICT makes collaboration possible by breaking down physical borders. It connects people, machines, economies, organizations, and governments in innovative ways. This trend is termed *pervasive collaboration*. Since this entire set of collaborative connections is underpinned by ICT, companies are presented with huge business opportunities for services innovation.

For as long as we can look back in history, mankind has derived well-being from burning things. Benefits and advances such warmth, light, and mobility have all been achieved through fire and burning. For the last 150 years, carbon has been fundamental to our economic prosperity and has played a huge role in our development. If the growth and development mentioned above continue with the same speed as they have over the past century, it will be disastrous for the environment. Resources such as coal and oil have powered the engines of growth in various industries over the past few decades without a thought to long-term sustainability. Cars were designed to deliver more power by guzzling more gasoline, power plants were designed without considering polluting factors, and factories were thrown up assuming an infinite availability and supply of raw materials. Many such lapses occurred in the course of development. This is where the third trend comes in. With the rise in awareness of the damage we are causing to the environment and to society at large, the focus on designing and consuming products of a sustainable nature is gaining acceptance. More than ever, people are willing to change their lifestyles if it contributes to a better world. In order to encourage this, the benefits of adopting sustainable, green products and services should reach the individuals that embrace them. In other words, it should be cheaper to be green than not to be. Measures could range from cheaper fuel prices or road taxes for "green drivers" to pay-as-you-drive types of insurance and carbon labeling of products and services that enable an individual to choose sustainability. Clearly, there is a need for newer business models within traditional industry sectors that cater to these newer needs. It is evident that these will be technology-intensive and that ICT companies will play a major role in delivering these solutions.

Each of the three trends above presents a huge opportunity in itself. However, when combined, the potential is immense and promises to forever change the way we live, work, and play. Each of these trends represents one leg of the economic opportunity triangle depicted in Figure 1. The three sides of the triangle—growth in the marketplace, pervasive collaboration, and transformation of the economy into a low-carbon/resource-efficient economy—together present the most significant economic opportunity of the next decade. This opportunity is supported and driven by both newer ways of doing business and people changing their behaviors. Over the next five years, green service offerings by the ICT industry are estimated to be worth US$1.2 trillion, according to a study by Insight Research Corp.[1]

Ushering in green behavior in society

Humans want to participate, to play a role, in what is going on around them. But they do not want to feel incompetent and helpless when they participate in society's good. There is a need for a good business model that understands and facilitates participatory problem solving, thereby easily invoking the desired behaviors and naturally motivating enlisted people to be a part of the solution. To successfully change behavior, the model should track and report on results—both individual and collective—in a concerted effort to create a sense of accomplishment; reporting should never be allowed to be perceived as the publication of a social defaulters list. Tracking (for example, the net reduction in greenhouse gas emissions from every car) and celebrating success should motivate others to participate actively rather than remain on the sidelines. A deep understanding of the "why" of human behavior is required before designing the "how" in all successful social changes.

Today, a facilitated, rapid transition toward a low-carbon economy is imperative if nations are to collectively address the challenges presented by climate change. For speedy mitigation of some of the most damaging impacts of climate change, a hitherto-unprecedented scale and pace of change is required. On this note, any model that should be seriously considered has to strongly align the needs of government and business while supporting the good of the taxpayers. Supportive regulatory and government policies should be at the core of business activity and operations, and these should help reward and drive social behaviors that work toward the desired de-carbonization effects.

Governments develop policies, legislation enshrines these policies in law, and strategies direct the body of policies and provide a framework for policy

Figure 1: The economic opportunity triangle

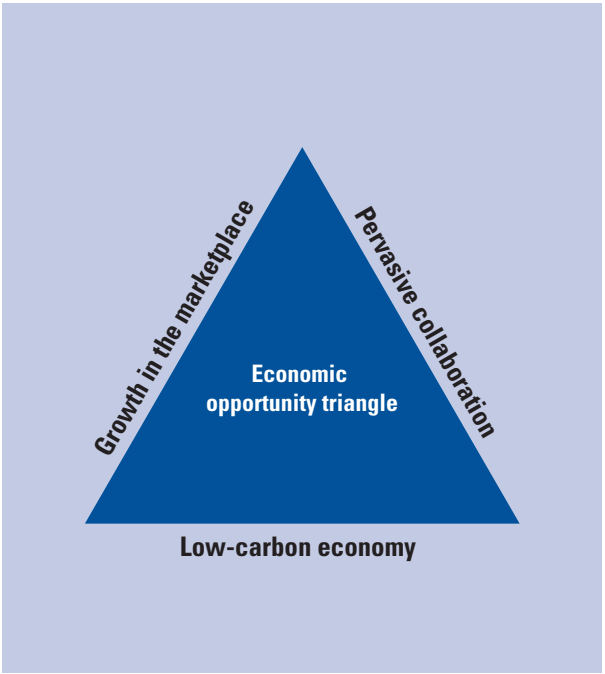


Figure 2: Collaborative ecosystem innovation

implementation. Individual policies themselves are rather meaningless when they are not based on an underlying national agenda. A strategic framework is necessary to help explain policy decisions and choices, and to give policies personality and direction. Many countries in the Asia-Pacific region have developed ambitious ICT strategies. In these countries, there are regulations and supervision mechanisms to ensure compliance. Policy statements and laws in themselves may not be sufficient to bring about the change that is sometimes necessary to transform business practices for the greatest possible diffusion of ICT.

Governmental vision and strategy for ICT should focus on people and not technology. For this to happen, it is important to develop both the ICT vision and the strategy with people in mind, and also to incorporate their input. National ICT policies and agendas can choose to be sector driven or to focus on broader issues and objectives, on benefits for society and the economy as a whole. Many ICT strategies in the past have adopted a sectoral approach to implementation. Although there are many types of strategies that various countries have adopted, an integrated approach to ICT development and deployment is most likely to yield success in human, social, and economic development over the long term.

Of special interest to ICT policy formulation are trade rules affecting telecommunications regulation and licensing. These rules are especially important in opening up the telecommunications sector to competition and foreign investment. Some consider the break-up of monopolies a prerequisite of increasing information flows and of encouraging the diffusion of ICT. Until the World Trade Organization agreements, the telecommunication markets in most countries had been closed to competition and had been operated by de facto monopolies—the national telecommunications operators. This is still the case in many of the non-signatory countries, and it is changing slowly in some of the signatory countries as well. For signatories, the end result will be similar in all cases: more open national and international markets for telecommunications goods and services.

Many countries have developed visions of the future where ICT is seen as an engine of transformation toward a desired state. Invariably, this future state is e-enabled. Some of the best known include Malaysia's Vision 2020, which foresees Malaysia becoming a fully developed country by 2020,[2] and e-Japan, which is a vision of a society "where everyone can actively utilise information technology (IT) and fully enjoy its benefits."[3] In Botswana, one tenet of Vision 2016, which proposes "prosperity for all," calls for Botswana to become an educated and informed society. Finally, the national vision for Canada is based on rolling out infrastructure to "make the information and knowledge infrastructure accessible to all Canadians, making Canada the most connected nation in the world."[4]

There is thus a very sensitive collaborative ecosystem innovation (Figure 2) that we must address if we are to successfully introduce working models that take

advantage of the economic opportunity triangle. Five principles ensure win-win-win among the public-private-government aspects of this collaborative ecosystem:

1. Reward compliance rather than penalize non-compliance.
2. Create business models that pass on incentives to participating citizens.
3. Make it financially attractive to be compliant.
4. Enable private good to lead up to and equate with public good.
5. Absolutely ensure that it costs less to be green than not to be.

As an example, let us consider the transport sector, which remains a major source of emissions. Low-carbon technologies already exist that can significantly reduce global emissions, but the enabling of frameworks and specific policy responses are needed to support the rapid deployment of those technologies, in both developed and developing countries. The government plays an important role in encouraging pro-green changes by levying differential duty to encourage the manufacture and take-up of cleaner fuels.

In this context, a favorable tariff treatment for unleaded gas since 1987 has significantly reduced the use of leaded gas, a major source of lead in the atmosphere. The success of this policy has helped facilitate the phasing out of leaded gas from January 1, 2000, in line with European Union (EU) directives. As a result of these measures, lead emissions from traffic have been cut to almost zero, with older cars—which are unable to use unleaded gas—switching to lead-replacement gas. Such indirect fuel taxes reduce CO_2 emissions in two ways: they have a direct impact on the number of miles driven and, indirectly, they encourage more fuel-efficient or alternate energy source–based vehicles.

It is by offering such incentives that we can advance environmental principles ensuring that cheaper, cleaner fuel is available in every garage, provide better deals for drivers, and facilitate cleaner air across the world. It is typical to ask motorists to bear the entire cost of driving—not only wear and tear and congestion on the roads, but the wider environmental costs. Any solution that helps cut fuel consumption or reduces emissions by encouraging certain behavior patterns or preferential changes ought to be given careful consideration.

We next introduce some working examples of such new-age models.

Intelligent emissions monitoring

Rising air pollution levels is a concern to governments and environmentalists across the world. Vehicular exhaust gases are the single largest contributors to air pollution. Greenhouse gases released into the atmosphere because of vehicular emissions caused by irresponsible driving behavior have an important impact on global warming and extreme weather conditions.

Transport is the fastest growing source of greenhouse gases (Figure 3). On the one hand, transport is vital for industrial development and the economy; on the other, it conflicts with environmental objectives that clamor for attention. Over the last 50 years, the industrial economy has replaced the agricultural economy and, as a consequence, cities all over the globe are feeling the effects of globalization and climate change.

There is a growing need for a solution to this universal problem. ICT can help address this. Creative use of technology coupled with innovation in business models and progressive policymaking will play a critical role in delivering CO_2 emissions cuts needed to meet global climate change targets.

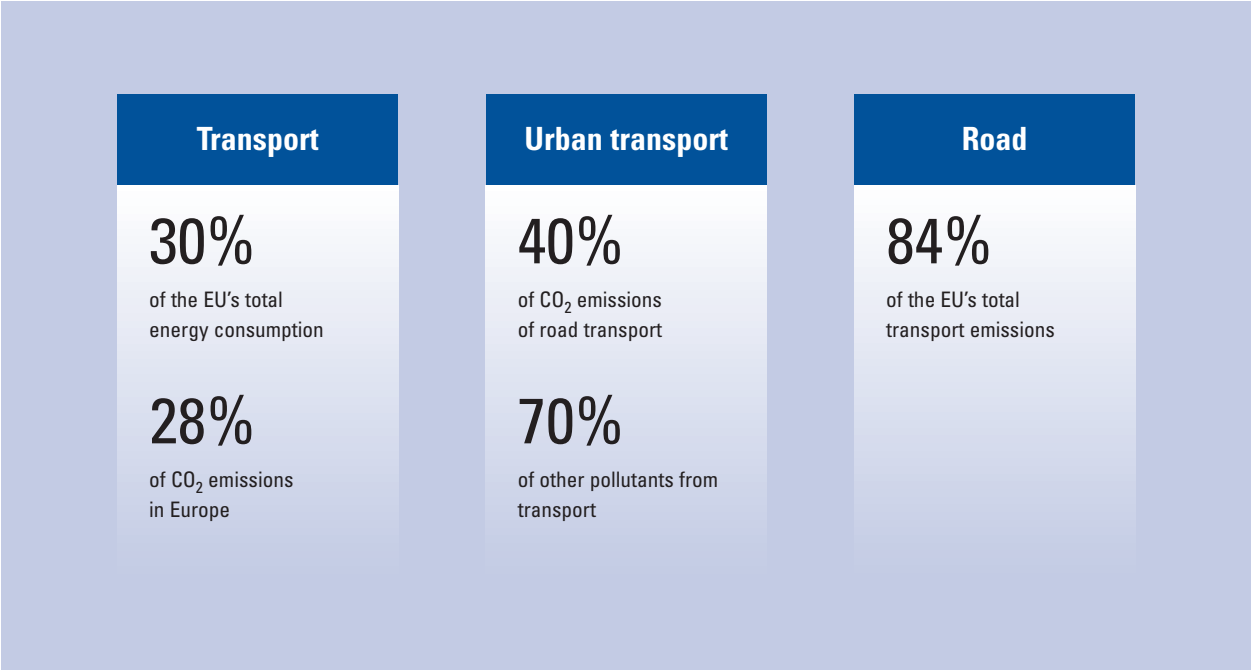
Personal mobility contributes to 51 percent of the carbon footprint for a typical household in the Western world.[5] Going by this figure, there is no way emerging economies such as India can replicate that model as-is; with an emerging work force of half a billion people, this would be a disaster. New-wave personal mobility must focus on creating a much more sustainable transportation system. Displaying the right behavior has a major role to play in the new scheme of things.

The big question is: on a social level, how does one promote green behavior in emerging economies that are unwilling to pay more for going green? Here, a creative business model will be one in which private good drives public good, a model that makes it financially attractive for individual citizens to be green. Models are needed that reward compliance rather than penalize noncompliance.

Modern technology allows real-time monitoring of vehicular emissions. Wireless emission data from cars can thereafter be used to offer differential fuel pricing to the vehicle driver.[6]

In this model, the fuel station offers a fuel price tailored to every individual vehicle and driving behavior. If the driving behavior is green, the fuel is priced lower; conversely, if the driving behavior is poor, the fuel price goes up for the next tank fill for that driver. This model enables drivers to improve their driving patterns and thereby empowers them to go green. By capturing real-time vehicle emissions values, it facilitates usage of these data for a number of purposes that change human behavior. The technology also offers audible feedback on the driving behavior of the driver in real time to allow him to alter his driving style to make the most efficient use of fuel. It measures emissions under actual driving conditions via a unit of measure called the *green index,* thus raising the driver's awareness through feedback and reward/penalty schemes for fuel prices using accurate and credible data.

Figure 3: Sustainable mobility



Source: Logica, 2009.

A sustainability offering modeled around these principles provides a high level of immediate driver orientation on how driving behavior impacts emissions and fuel consumption.

There are two compelling reasons why such ICT-driven green models are proving successful:

- According to Logica's research, feedback on their driving patterns has helped drivers become aware of their driving behaviors; an improved driving behavior was noted in 95 percent of the cases.

- Some overall fuel savings and associated emissions of up to 15 percent could be recorded with the adoption of this sustainability model. Driver profiling and training also contribute to this fuel savings. Decrease in fuel consumption is observed as a result of decrease in excessive speeding, braking, and idling times. Audible notifications alert the driver in real time and help to modify driving behavior, which in turn helps to reduce fuel consumption.

There is another dimension to this model that helps drive social acceptance. Traditionally, the car has been positioned as a social statement of "who you are." It is time to introduce a new paradigm by positioning not the car but its value on a green index as a social statement.

Readings from the green index would appear on various social media, and your reading would become the new statement of "who you are." One would have to visualize people proudly posting their green rating on their social profiles (such as Facebook, MySpace, Twitter). People would compare their ratings with those of others and of friends, enabling the entire network to take notice.

ICT also drives progressive policymaking by government and regulatory bodies. It acts as a catalyst for policy changes toward a greener environment, enabling governments to implement policies and programs that reward initiatives toward reduced vehicle emissions. ICT, hence, exerts its influence on regulatory changes that will continue to have a powerful impact on driver behavior.

Over a period of time, the differential fuel pricing type models hold the potential to tip social behavior in the direction of greener options in personal mobility. ICT companies can work with governments, regulatory bodies, and oil retail companies as well as individual citizens to create an ecosystem where technology coupled with progressive policymaking drives the overall societal good. Any new business model that aims to successfully change behavior in a significant way must enlighten, inform, and empower users. This example does just that and is a forerunner of many more such ICT-based green aids to come.

Other than eco-driving and support, the energy efficiency in the transport and logistics sector can be improved by deploying ICT systems such as:

- traffic management and control,
- navigation and guidance,
- access and demand management,
- freight logistics and fleet management, and
- higher penetration of in-vehicle safety devices to avoid accidents and related congestion.

Pay-as-you-drive insurance

If one adds insurance companies and an insurance regulator to the model of pervasive collaboration platform cited above, one can create another business model called *pay-as-you-drive (PAYD) insurance.*

Vehicle insurance is generally considered a fixed cost, irrespective of the amount of vehicle usage. Usage-based insurance makes vehicle insurance more actuarially accurate (the premiums better reflect the claim costs of each vehicle) and gives motorists an opportunity to save money when they reduce their mileage. It can help achieve several public policy objectives, including road safety, consumer savings and choice, congestion reduction, and environmental protection.

In the near future, ICT will help enable every vehicle to have "intelligence" so that they act as connected nodes in the dynamic traffic network. Vehicles will be able to constantly exchange contextual information such as traffic status, infrastructure usage, and sustainability parameters to avail various services. At the heart of this vision is an integrated plug-and-play device that will get installed in every vehicle. Several unified services will be built around this smart device, and the unified service offering could include PAYD insurance.

PAYD service models calculate premium balances in real time based on distance, time, and speed of the vehicle, using an on-board device (Figure 4). The on-board device uses existing global system for mobile communication technology to transmit the data to an application at the back-office server. Motorists are notified of periodic updates on mileage using text messages. The service provides motorists with options to top up their insurance premium even as they travel, using text messages and the Internet. PAYD service models allow for the customization of insurance premiums using customer-specific rate plans. The system incorporates well-defined open interfaces to facilitate quick integration with existing insurance applications.

So how does all this help in incentivizing pro-green changes to social behavior? Insurance companies have always tried to differentiate and reward "safe" drivers, giving those who qualify lower premiums and/or a no-claims bonus. However, conventional differentiation is a reflection of past history rather than present patterns of behavior. What if, instead of paying for your insurance in the beginning of the year, you could pay it every time you drive? This in itself is a great incentive to drive less and thereby reduce your insurance cost. For insurance companies it reduces risk and for society it reduces driving; people become more aware of the fact that, as with fuel, the amount they pay for insurance depends on how much they use their vehicle, and that they can control such usage. Moreover, PAYD provides a much more immediate feedback loop to the driver: by changing the cost of insurance dynamically with a change of risk, drivers have a stronger incentive to adopt safer practices. This is a huge catalyst of behavioral change. It is estimated that if all motorists were to switch to PAYD insurance service models, the world's total oil consumption would decrease by 12 percent per car. This in turn, would dramatically reduce CO_2 emissions.[7]

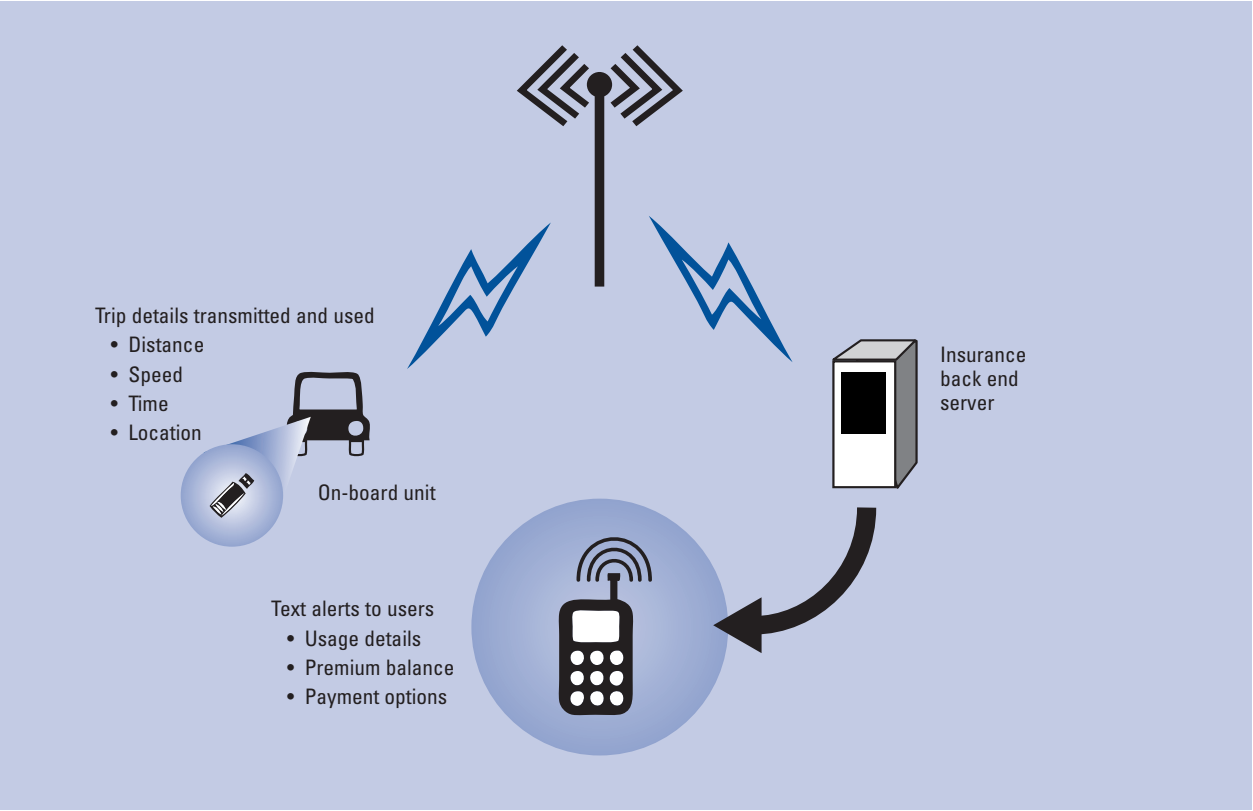
A recent study in the United States estimated that a PAYD-based insurance model would reduce driving nationally by 8 percent.[8] Such a reduction in driving would reduce CO_2 emissions and oil consumption by an estimated 2 percent and 4 percent, respectively. Only increasing the gasoline tax by US$1 per gallon could achieve the same reduction in driving. However, unlike an increase in the fuel tax, PAYD would save most drivers money regardless of where they live. Almost two-thirds of households would pay less for auto insurance, with each of those households saving an average of US$270 per car. In short, PAYD represents a win-win policy. What is good for drivers, in this case, is also good for society.

Travel Together

There are millions of us who engage in solitary travel to and from work, cumulatively driving billions of miles each year, spending heavily on gas, and pumping tons of emissions into the atmosphere. According to urban travel standards (single-passenger statistics), a small car emits around 0.59 pounds of CO_2 per mile, a medium car emits around 1.10 pounds of CO_2 per mile, and an SUV/4 wheel drive vehicle emits around 1.57 pounds of CO_2 per mile. This, in itself, is a huge contributor to the carbon footprint of a society that supports such usage.[9]

Formal carpooling is thought to have emerged in mid 1970s, probably because of the oil crisis at that time. Carpooling not only supports sustainability by reducing fuel consumption, vehicular emissions, and congestion, but it also directly benefits users by reducing the stress and cost of travel. However, for carpooling to work, each member must own a car that can be shared on a rotational basis, and members of the carpool should live or work close to each other. Some companies have been experimenting with a new socio-business model called *Travel Together,* offering a different social-cum-economic stimulus that enables carpooling to work even when members do not own a car or do not live or work close to each other.

Figure 4: Insurance premiums and vehicle usage



Source: Logica, 2008a.

Travel Together brings together individuals who drive their car to work and would like to share with those who do not drive but would like to share part or the entire trip. It enables the users of the service to share the cost of the ride based on the distance traveled by each unique user, potentially turning every private vehicle into a shared node in the transport network.

Travel Together promises to change the dynamics of shared transport and transform people's commuting experience. It does this by fusing a social networking element into the usual car pooling system. Any person who wishes to travel together registers first on a site by giving his/her personal credentials, which are validated and stored in the system. The owner of a group can publish a route by providing details such as start point, end point, via points, timing, vehicle details, and seat availability, among others. The routes can be ad-hoc or planned as per a published calendar. Alternatively, registered users can search published routes and if the route details match their requirements, they can contact the route owner, citing their interest in joining that group and indicating their preferred pick-up and drop points on that route.

Once a route owner accepts a user's request, the user is notified that he/she is now a member of the carpool for that route. At the time of registration, each user's account is linked with his/her debit or credit card. The person who provides the service will get points credited to his/her account based on the distance for which the service was offered to each user. These points are debited from the accounts of the individuals who availed the service and settled at regular intervals; fees paid by non-car users are netted off by "money received" by the car/group owner of that route. This model encourages those who prefer to drive to volunteer their vehicles for carpooling, as they can recover part of the travel cost by providing a mutually beneficial transportation service to others who prefer not to drive. It also throws in exciting social networking possibilities, with Web 2.0 features supporting the online application. One can blog on the site or choose one's co-travelers based on their social profile as well as local proximity. Collaborative play thus allows for the full use of seats, saves on fuel, and reduces the emission contribution per person.

Smart buildings

More than 40 percent of the energy consumption in Europe is for heating, cooling, and lighting operations within buildings.[10] Moreover, buildings are the largest

source of CO_2 emissions in the European Union. The majority of energy consumption is caused by space and water heating within households, although the share of consumption of lighting and appliances is rising over time (this is similar to the situation within the services sector, although the share of lighting and appliance consumption is higher there than in households because of a greater utilization of ICT equipment).

Worldwide energy consumption for buildings will grow by 45 percent by 2025, when buildings will account for about 40 percent of energy demand, with 33 percent of that demand in commercial buildings and 67 percent in residential buildings.[11]

Five areas in which energy efficiency can potentially be improved through the use of ICT have been identified, as below:

- **Design and simulation tools.** When new buildings are built, designers can apply ICT tools to plan buildings that minimize energy consumption. For example, consider simulating and optimizing envelope measures and passive solar heating techniques. By achieving significant improvements in buildings' energy performance via monitors and sensors, one could more accurately measure usage, system status, and equipment conditions. It is also possible to obtain full price information, dynamic tariff, and demand response, thereby allowing more energy-efficient customer choices, value-added services, and better-integrated demand-side automation.

- **Interoperability standards.** Most building control systems today are based on localized microprocessors with hardwired sensors controlling single functions. It is not unusual to have separate controllers for heating, cooling, air conditioning, and so on. There are significant opportunities for efficiency but most are lost because of a lack of integration and compatibility. The most appropriate solution would be to use a single control system that governs all heating, ventilation, and air conditioning (HVAC); lighting and other electrical applications; and related subsystems installed in a building. The main barrier to this logical solution is the fact that the different subsystems are manufactured and often installed and even operated by different companies.

- **Building automation.** In the area of home automation, which is primarily perceived as improving the quality of life (for example, more comfortable, safer homes), ICT has the potential to contribute to energy efficiency through the use of improved control and management systems based on smart appliances and communication networks.

- **Smart metering.** This technology enables more accurate measurement of consumption via the use of advanced meters that are connected to a central unit through a communications network, improving data collection for billing purposes. Smart metering provides information on consumption patterns, thus contributing to more sustainable consumption and energy savings.

- **User-awareness tools.** Providing intuitive feedback to users on real-time energy consumption has significant potential to change behavior on energy-intensive systems usage. Various studies have shown that energy consumption could be reduced by 5–15 percent by implementing this measure.[12]

Smart electricity grids

Energy generation and distribution use one-third of all primary energy. Electricity generation could be made more efficient by 40 percent and its transport and distribution by 10 percent. ICT could not only make the management of power grids more efficient but also facilitate the integration of renewable energy sources.[13]

Heating, cooling, and lighting buildings account for more than 40 percent of European energy consumption. The introduction of real-time updates on their energy consumption stimulates consumer behavioral changes. In Finland, this smart metering encouraged consumers to reduce energy consumption by 7 percent. According to the French regulator Commission de Régulation de l'Energie (CRE), the implementation of smart metering would decrease residential consumption by up to 5 percent and decrease CO_2 emissions by as much as 5 percent.[14]

The integration of ICT tools for the management of distribution and the use of smart meters at the consumer location, with telecommunication networks forming an intelligent network capable of supporting distributed generation plants, is generally known as *active distribution networks* and *advanced metering infrastructure within smart grids.* ICT enablement of the smart grid, via such things as two-way communication between grid operators and customers; pervasive control systems through substation, distribution, and feeder automation; and decision-support systems that increase predictive reliability should be supported.

Green consumerism: The next market mantra

A growing number of consumers are beginning to realize the environmental and social significance of their purchase decisions as related to the variety of brands available today. This trend can be an opportunity for placing consumers in a position to demand green products from their manufacturers and even retailers. To help individuals make appropriate, informed choices, manufacturers and retailers need to have a deep understanding of consumers' lives and consumption patterns so they can determine the best engagement model

aligning attitudinal and behavioral changes to a greener world.

Everything we produce, buy, and use has a carbon footprint. The carbon footprint of a product or service is the total CO_2 and other greenhouse gases emitted during its entire life, from production to use and disposal. Until now, everything we consume has been taken for granted in terms of renewability and sustainability: no business, government, or society cared to ask what is more damaging to the air we breathe—airlifting oranges from halfway across the world or growing them locally in greenhouses. The global call to action on climate change has put pressure on companies to measure the volume of CO_2 and other greenhouse gases for which they are responsible. Such footprints are typically communicated by using *carbon labels.*

Carbon labels show a product's carbon footprint from source to store and further, until its disposal. They convey this information to consumers as a simple numerical value; by using this value, they can then make an informed responsible purchase choice at the point of sale.

Carbon labeling can potentially lead to changes in consumption, market, and business behavior by:

- informing consumers of the carbon contribution of the product or service they are planning to purchase, which can potentially influence purchasing decisions;
- engaging consumers to educate themselves about products high in carbon content, which can potentially influence changes in lifestyles;
- enabling manufacturers to gain differential posi-tioning (and even branding) based on green credentials;
- enabling/encouraging manufacturers to improve their efficiency and influence the supply chain to move toward cleaner methods and means of manufacturing; and
- providing retailers with new marketing and business models to engage with consumers based on carbon thresholds and green shopping habits.

Carbon labeling thus holds tremendous potential to lead to positive consumer behavior changes and make the entire supply chain aware of the impact of various component steps on climate change. This is the case provided that the challenges of achieving international consensus, objectives, and processes and standards on accessible, auditable carbon estimation and labeling are overcome.

ICT can help in measuring and tracking the carbon label for each consumable. However, what we have today are static labels. Static CO_2 labels do not capture dynamic parameters that influence individual products: transportation, refrigeration, and heating are some prime examples. What if one had a way to see the update dynamic carbon label of a product one wishes to purchase on one's mobile handset?

Figure 5 shows how near field communication (NFC) technology could be leveraged to display dynamic carbon labels of prospective purchases on consumers' mobile phones. This provides consumers with real-time carbon information that takes into account the dynamic nature of carbon emissions and the potential difference in footprints between instances of the same product from different producers or even different batches from the same producer. This leads to behavioral changes in consumer patterns: people check not just the nutritional information on a loaf of bread but also its carbon label before deciding on the purchase.

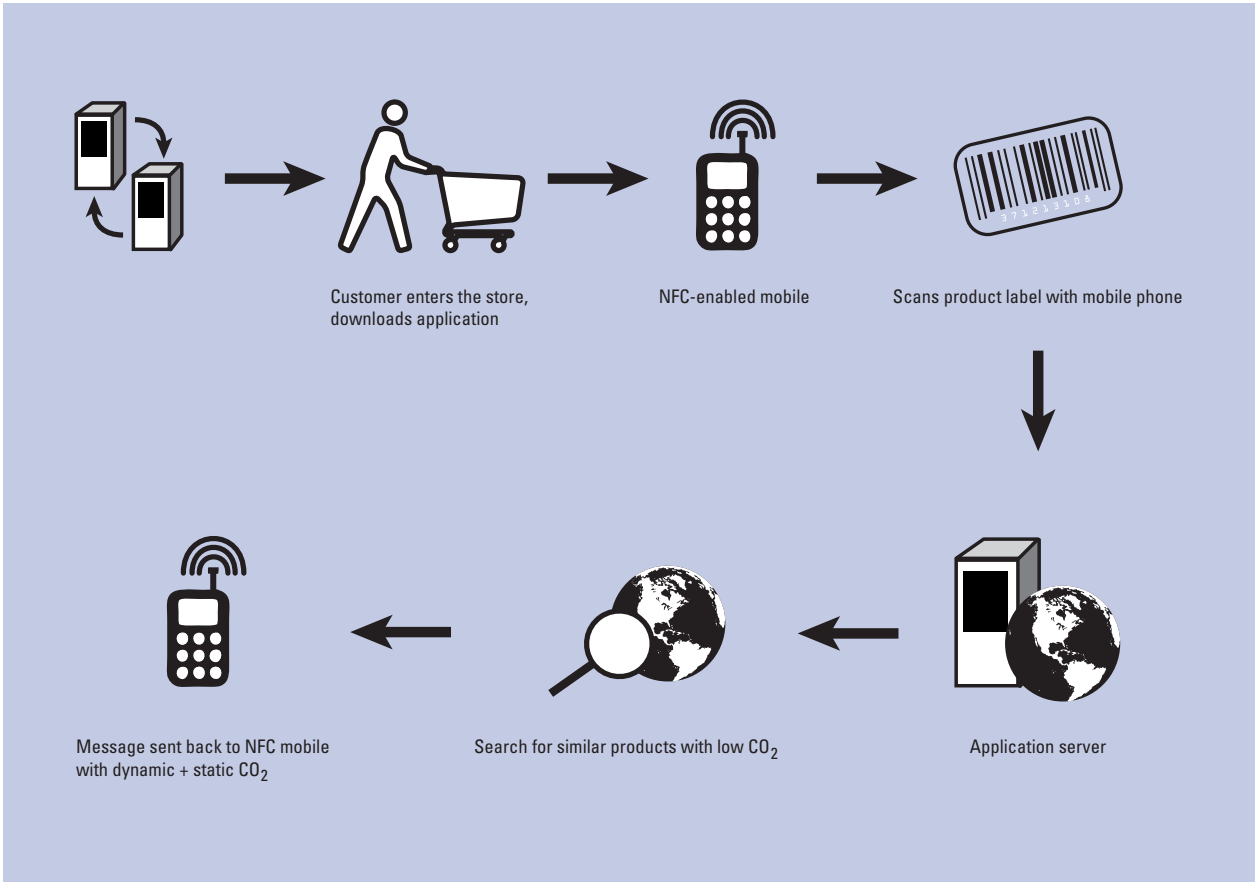
From a business perspective, competing in the low-carbon economy requires the right tools to brand right in order to take advantage of such opportunities; ICT helps organizations with the right green capabilities and skills to differentiate themselves from competitors who are "less green." Again, government policies should be framed in such a way as to reward producers with a smaller carbon footprint. This, in turn, translates into buying fewer carbon credits to offset any negative balance and is, hence, cheaper (besides being healthier) in the longer run. For reducing emissions, carbon labeling on its own would not be sufficient, but it is a tool that can help create increased awareness among consumers and demand for green products and services from the market.

Conclusions

ICT is a powerful enabler of green behavior through new business models aimed at reducing emissions in almost any sector, notably in smart buildings, smart grids, reduced travel, improved energy efficiency, and so on. ICT can do this primarily by combining new business (services) opportunities that effectively help abate CO_2 emissions from traditional arrangements to the tremendous potential for growth offered by an exploding marketplace. This is the economic opportunity triangle. The best of such working models secures a win-win-win ecosystem among business-society-government.

ICT-based travel-optimizing solutions can help reduce or substitute the travel requirements (both business and personal) of people and goods. A second area where ICT has been extensively used for reducing CO_2 emissions caused by transport is in the use of green intelligent transport system (ITS) solutions, the three main elements of which are the vehicle, the infrastructure, and the driver. ITS can enlighten, inform, and support behavioral change for the key players in green

Figure 5: Empowering consumers to choose low-carbon products



Source: Logica, 2008b.

ITS models. A third way in which ICT can assist other powerful sectors of the economy in reducing greenhouse gas emissions is through allowing consumers to make carbon label–based choices at the point of sale itself.

We have touched on only some examples in this chapter. There are innumerable other smart green models being attempted in the world today: among them are variable congestion, parking, and road-usage fees based on how environmentally friendly the vehicle being driven is; smart parking and smart charging solutions that guide the driver to the nearest available parking space and charging point, thereby reducing the extra cruising around (and pollution) required to find a place to park. All these examples we now see breaking in our midst are just the tip of the opportunity iceberg where ICT can induce and catalyze pro-green behavioral changes through innovative, smart business models.

Notes

1 Insight Research Corporation 2008.

2 Mohamad 2008.

3 Prime Minister of Japan, e-Japan Strategy 2001.

4 Industry Canada 1998.

5 See U.S. Department of Energy 2007.

6 See U.S. Department of Energy 2007.

7 Logica's study and inference are based on following sources:

- http://www.brookings.edu/papers/2008/~/media/Files/rc/papers/2008/07_payd_bordoffnoel/07_payd_bordoffnoel.pdf
- http://www.dft.gov.uk/pgr/statistics/datatablespublications/intcomparisons/
- http://www.worldometers.info/cars/

8 Bordoff and Noel 2008.

9 Sightline Institute 2007.

10 eu.bac 2008.

11 European Commission 2009.

12 European Commission 2008.

13 European Commission 2009.

14 European Commission 2009.

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