

# Ecosystem Services and the Automotive Sector

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## The Impact of Automobiles on Ecosystems and Biodiversity

Our lives depend on the natural environment. The ecosystem provides great blessings for humankind by supplying food and freshwater and offering many “services,” such as regulating the climate and offering protection from natural disasters. Humans, on the other hand, use energy and water resources and pollute the air, water, and soil, which have adversely affected the ecosystem and biodiversity. The Millennium Ecosystem Assessment carried out between 2001 and 2005 with support from the United Nations points out that the world’s ecosystems have declined more rapidly and extensively over the past 50 years than at any other comparable time in human history. Maintaining healthy ecosystems and biodiversity is an environmental issue of crucial importance alongside mitigating climate change.

Since 2007 Nissan has been conducting joint research with the United Nations University Institute of Advanced Studies on the impact automobiles have on the ecosystem and biodiversity. Assessments of such impact and benefits received from ecosystem services have been made utilizing the guidelines in the Corporate Ecosystem Services Review (ESR), developed at the same time as the Millennium Ecosystem Assessment. Nissan identified the priority areas it should address as an automaker and considered the best approaches.

The ESR is a structured methodology to help businesses develop strategies by supporting companies understand their dependence and impact on ecosystems. The ESR methodology consists of five steps: (1) select the scope, (2) identify priority ecosystem services, (3) analyze trends in priority services, (4) identify business risks and opportunities, and (5) develop strategies.

The value chain for an automaker encompasses a broad range of activities, from the securing of material resources to the production, distribution, and operation of vehicles; energy consumption; servicing; recycling of end-of-life vehicles; and office-related tasks (communication, foods, use of water, etc.). The current study targets 10 areas ranging from upstream to downstream activities and reviews how they are related to major ecosystem services to assess their level of importance. Over 20 ecosystem services were analyzed and studied, as a result of which the most important for an automaker were identified as being energy, material resources, and water resources.

Automobiles depend almost entirely on oil for energy. The consumption of oil has been linked to climate change through the emission of greenhouse gases and to the degradation of the ecosystem through the drilling of oil wells and contamination of water and soil during transport. Such impact may be reduced through either improvements in energy efficiency or a shift to such alternatives as biofuel, renewable electricity, and hydrogen. While biofuel is an important option, it must be produced through sustainable methods that consider the impact on water and the soil. Renewable electricity may emerge as a realistic choice, as it has little impact on climate change and on ecosystem services.

The securing of material resources is accompanied by the excavation of surface soil and the large-scale logging of forestland. The construction of roads, ports, and other infrastructure can also damage the ecosystem. It will be important to give thought to the impact on the ecosystem when selecting the necessary materials

for vehicle production and to reduce the use of virgin materials through reuse and recycling.

Water resources are also emerging as a critical issue. Regional water shortages and water contamination are impacting agricultural production and the ecosystem. And there have been some cases of industrial uses of water affecting people’s drinking water, leading to criticism from local communities. Global water stress is likely to rise in the future due to population growth, economic development, and climate change. In localities with high water risk, automotive plants, too, should implement water recycling and purification measures.

Nissan is advancing concrete measures in various fields in recognition of the impact automobiles have on the ecosystem and biodiversity. We have improved the energy efficiency of engines to reduce oil consumption, marketed biofuel vehicles, and developed fuel cell vehicles. And in 2010 we launched the Nissan LEAF, a 100% (or ‘fully’) electric vehicle, in the Japanese and US markets; the Leaf will be sold worldwide from 2012. We have already achieved a 95% effective recycling rate in Japan for the resources contained in end-of-life vehicles and are working toward the ultimate goal of 100% globally. We have conducted water risk surveys in our factories around the world, and we are aiming for zero wastewater discharges through the use of reverse osmosis filtration systems. We will continue to ascertain the impact automobiles have on the ecosystem and biodiversity from a broad perspective and address this issue on a global basis going forward.

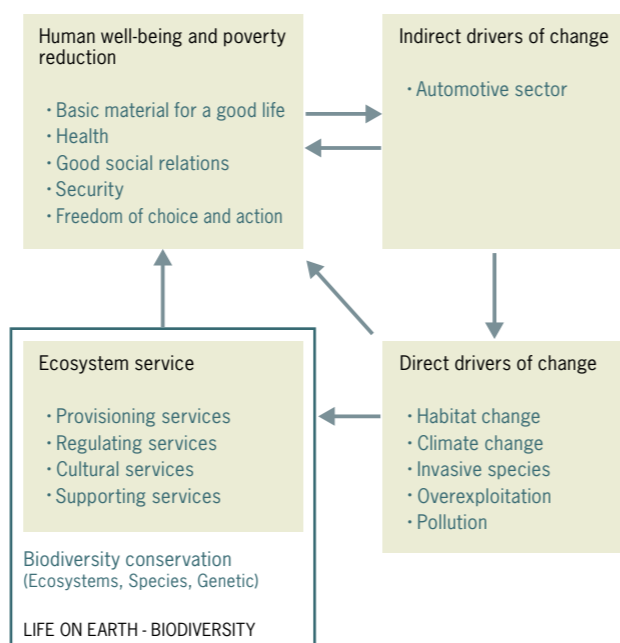
# 1. BIODIVERSITY AND ECOSYSTEM SERVICES

## Introduction

The Earth's freshwater, born as rain and snow on mountaintops, the trees making up a rich, dense forest, the climate that stabilizes natural hazards like floods and fires, all the species that make up biodiversity, and the refreshing, peaceful calm provided by nature—these are all blessings of the ecosystem that sustains and enhances human lives. Changes in the ecosystem can influence the way we live, from access to basic materials to health, good social relations, security, and the freedom of choice and action.

In 2005 the Millennium Ecosystem Assessment (MA) organized by United Nations represented current state of ecosystem services that are provided by nature in its healthy state and the future outlook. The MA indicated a lot of considerable evidences in that our economic activities are heavily dependent upon and greatly influence ecosystem services. This report provides a quick sketch of the relationship between ecosystem services and the automotive sector, based on the MA's conceptual framework of interaction between biodiversity, ecosystem services, human well-being, and human-induced drivers of change.

**Figure 1. Interaction between Biodiversity, Ecosystem Services, and the Automotive Sector**

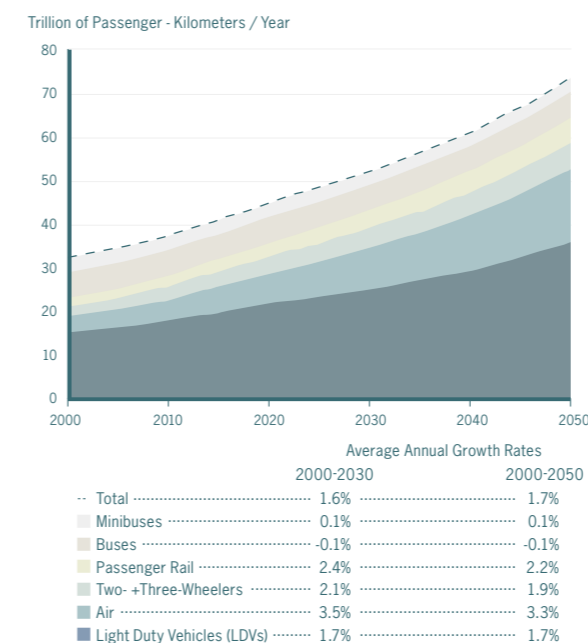


Source: Compiled by Nissan based on the Millennium Ecosystem Assessment, 2005.

## Biodiversity and Ecosystem Services

Economic growth creates demand for transport services. According to the Sustainable Mobility Project, which was conducted by the World Business Council for Sustainable Development, personal transport activities are projected to increase significantly over the next several decades, and land transport, such as light-duty and two-wheel vehicles, is expected to play a key role in meeting our mobility needs. In addition, the project indicated that the transport-related impact on the ecosystem was a significant way to measure the sustainability of our mobility.

**Figure 2. Personal Transport Activity by Mode**



Source: World Business Council for Sustainable Development, Mobility 2030: Meeting the Challenges to Sustainability, 2004.

In terms of global environmental issues, the climate change debate has dominated the environmental discussion for decades, but increasing attention is being drawn to protecting and investing in biodiversity and the ecosystem. The Millennium Ecosystem Assessment provided a state-of-the-art scientific appraisal of the conditions and trends in the world's ecosystems and the services they provide. The assessment was a four-year study to connect ecosystem services, human well-being, and business development involving more than 1,360 scientists, economists, business professionals, and other experts from 95 countries. The assessment discovered that ecosystems have declined more rapidly and extensively over the past 50 years than at any other time in history. Contributing to the decline have been the conversion of forests to cropland, increased use of nitrogen fertilizers, contamination of waterways, water

withdrawals from rivers and lakes, decline of coral reefs that buffer coastlines from storms and static hauls of wild marine fish due to over-harvesting. The assessment projected further declines in the coming decades, especially with the economic growth of developing countries, population growth, and global climate change.

Automobiles impact ecosystems through their production, use, repair, and recycling, and at the same time depend on ecosystems. Ecosystems provide businesses and people with a wide range of goods and services. In the automotive sector, among others, ecosystems provide freshwater to source biofuels and the hydrogen for fuel cell vehicles, mineral resources for production, and climate regulation through the absorption of carbon dioxide. Conversely, the sector has affected ecosystems' regulation of natural hazards through the hydrocarbon extraction of fossil fuels. The benefits from nature are known as "ecosystem services." Biodiversity, or the variability among living organisms within and between species, is also important in this regard as it underpins the supply of ecosystem services. The depletion of fundamental resources in our environment is a concern for us all, for without healthy and replenished ecosystems, biodiversity is endangered and so are businesses that depend on it. Ecosystem degradation is relevant and important for businesses for its direct impact on ecosystems and their dependency of the services ecosystems provide. There is increasingly larger impact on ecosystem services, and while we are still benefiting from them now, their future is in jeopardy.

The MA defined four ecosystem service categories: (1) provisioning services, or goods and products obtained from ecosystems, such as food, freshwater, timber, and fiber; (2) regulating services, or benefits from the ecosystem's natural regulating processes involving climate, disease, soil erosion, water flows, and pollination, as well as protection from natural hazards; (3) cultural services, or the spiritual and aesthetic enjoyment derived from nature; and (4) supporting services, or such natural processes as nutrient cycling and primary production that maintains other services. Table 1 is a list of ecosystem services as defined by the World Resources Institute, based on the Millennium Ecosystem Assessment.

Meeting the bottom line can no longer be the single objective for businesses. Most do not recognize the business opportunities that emerge from risk, and most

focus on environmental impacts rather than dependence. Businesses, in fact, are well positioned to pursue new business opportunities, reduce their ecological footprint, develop and deploy new technology, and lead policy reform to raise environmental standards and competition.

**Table 1. Definitions of Ecosystem Services**

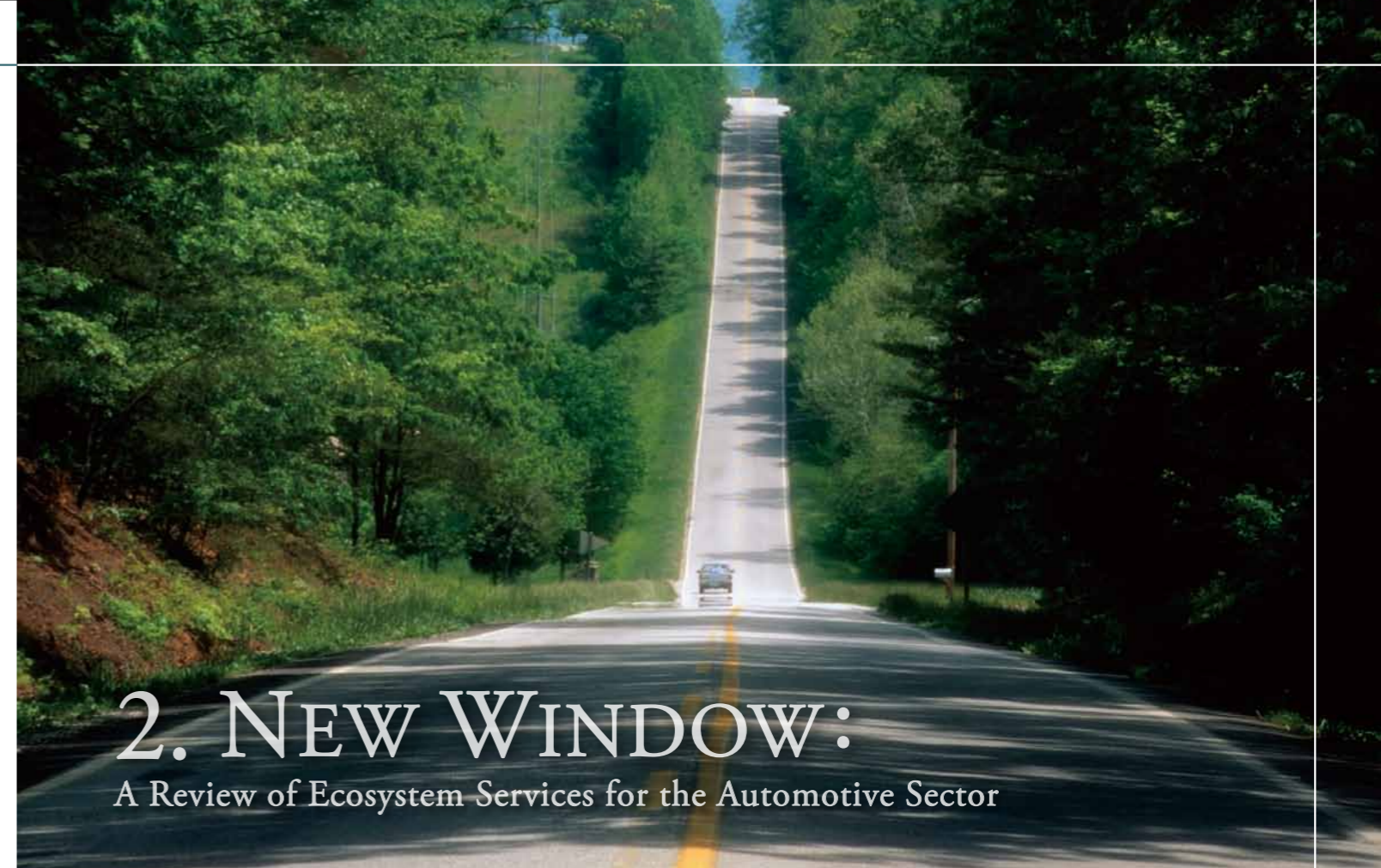
Service	
Provisioning services	Food
	Fiber
	Biomass fuel
	Freshwater
	Genetic resources
	Biochemicals, natural medicines, and pharmaceuticals
Regulating services	Air quality regulation
	Climate regulation
	Water regulation
	Erosion regulation
	Water purification and waste treatment
	Disease regulation
	Pest regulation
	Pollination
	Natural hazard regulation
Cultural services	Recreation and ecotourism
	Ethical values
Supporting services	Nutrient cycling
	Primary production
	Water cycling

Source: Adapted by the World Resources Institute from the reports of the Millennium Ecosystem Assessment, 2005.

## Aim of the Initiative

The Millennium Ecosystem Assessment was innovative in that it brought business and the environment together, linking institutions that deal with the development and the protection of the environment. Traditionally, businesses have focused on the negative aspects of environmental issues, such as regulation, damage to brand image, increased input costs, increased vulnerability to environmental change, and conflict and corruption resulting from scarcity of ecosystem services. However, there are also market and product opportunities for businesses by incorporating ecosystem services into their strategic planning to enhance their corporate image and meet future sustainability challenges.

The aim of this collaborative research is threefold. Firstly, it evaluates the automotive sector's activities and performance with regard to ecosystem services, rather than focusing on standard issues, such as carbon emissions. Secondly, it assesses the automotive sector's dependency on ecosystem services and impacts of its products on the environment based on the Corporate Ecosystem Services Review (ESR) framework and methodology. Lastly, it serves as a strategic planning tool for corporations to become better stewards of the environment through analysis of its opportunities and threats. This innovative and pioneering joint study systematically links the automotive industry and the environment together for sustainable mobility for today's and future generations.



## 2. NEW WINDOW: A Review of Ecosystem Services for the Automotive Sector

Corporations around the world are increasingly recognizing that sustainability—that is, the full composite of long-term social, economic, and environmental factors and considerations—is integral to business strategy. The business environment is rapidly changing as we confront the limits of our global ecosystem. At the same time, there are widening social expectations that multinational businesses solve or at least address some of the most pressing global problems, such as climate change, biodiversity loss, and poverty. As public interest in the environment and sustainability grows, there is increasing pressure to mainstream sustainability into long-term policy and strategy perspectives at the society level and into lifestyle and consumer choices at the individual level. This is prompting more and more corporations, including in the mobility sector, to integrate sustainability as a core concern in their business models. These corporations are taking a long-term systemic approach in examining the direct and indirect impacts of their operations and products, as well as tackling the challenging task of understanding how these factors interact with one another.

To build a society with sustainable mobility, there is a need to rethink the role of mobility and even to change our lifestyles. To begin understanding the diverse impacts and achieve the perceptual and eventually operational

shift, we need to look at the mobility sector through the lens of ecosystem services—that is, we need to go beyond simply looking at where the mobility sector has made strides to achieve environmental friendliness and to go deeper and critically analyze and understand how the mobility sector depends on and in turn influences global, regional, and local ecosystem services. To do so, we employed the Corporate Ecosystem Services Review (ESR) methodology, as detailed below.

## 2.1 The Corporate Ecosystem Services Review

The Corporate Ecosystem Services Review (ESR), developed by the World Resources Institute with support from the World Business Council for Sustainable Development and the Meridian Institute, provides corporate managers with a proactive approach to making the connections between ecosystem change and their business goals. Ecosystems provide businesses with numerous benefits or ecosystem services. However, human activities are degrading these and other ecosystems. Left unchecked, this degradation could jeopardize the future economic well-being of humans and businesses.

The Millennium Ecosystem Assessment (MA) shed light on the importance of ecosystem services for human well-being and business development. This four-year international audit of ecosystems—which involved more than 1,360 scientists, economists, business professionals, and other experts from 95 countries—provided the first state-of-the-art scientific evaluation of the conditions and trends in the world’s ecosystems and the services they provide, as well as the scientific basis for action to conserve and use them sustainably. The categories of ecosystem services are:

- Provisioning services: Goods or products obtained from ecosystems, such as food, freshwater, timber, and fiber.
- Regulating services: Benefits obtained from an ecosystem’s control of natural processes, such as climate, disease, soil erosion, water flows, and pollination, as well as protection from natural hazards. “Regulating” in this sense is a natural phenomenon.
- Cultural services: Nonmaterial benefits obtained from ecosystems, such as recreation, spiritual values, and aesthetic enjoyment.
- Supporting services: Natural processes, such as nutrient cycling and primary production that maintain the other services.

### Key Terms:<sup>1</sup>

- An **ecosystem** is a dynamic complex of plant, animal, and micro-organism communities and their nonliving environment interacting as a functional unit.
- **Ecosystem services**, also called environmental services or ecological services, are the benefits people obtain from ecosystems. They include freshwater, timber, climate regulation, protection from natural hazards, erosion control, and recreation.
- **Minerals and fossil fuels**, such as coal, oil, and natural gas, are natural resources but not ecosystem services. The quantity and quality of minerals and fossil fuels are not dependent upon the living components of existing ecosystems, and there are no benefits derived from ecosystem services, although fossil fuels and some minerals come from organic matter that was alive millions of years ago.
- **Freshwater** is an ecosystem service as the quantity and quality is often dependent upon living components of ecosystems. Forests affect the quantity and quality of freshwater in a region by soaking up water through tree roots, releasing water vapor through leaves, and preventing siltation of rivers.
- **Biodiversity** is the variability among living organisms within species, between species, and between ecosystems. Biodiversity is not in itself an ecosystem service **but rather it underpins the supply of ecosystem services.**

<sup>1</sup> From the World Resources Institute, The Corporate Ecosystem Services Review: Guidelines for Identifying Business Risks and Opportunities Arising from Ecosystem Change.

Although buffered against ecosystem change by culture and technology, all people and businesses fundamentally depend on the flow of diverse ecosystem services that sustain our lives on Earth. The MA found that 60% of the ecosystem services evaluated were degraded over the past 50 years. Humans have changed the Earth’s ecosystems more rapidly and extensively than in any comparable period of time in history, largely to meet our rapidly growing demands for food, freshwater, timber, fiber, and fuel. Some of these examples are the conversion of land to cropland, increased usage of nitrogen fertilizers, contamination of waterways, water withdrawals from rivers and lakes, decline of coral reefs that buffer coastlines from storms, and static hauls of wild marine fish due to over-harvesting.

The MA clearly recognizes that the changes that have been made to our ecosystems have contributed to substantial net gains in human well-being and economic development but also points out that these gains have been achieved at growing costs in the form of the degradation of many life-sustaining ecosystem services and that the current approach, over the long term, is not sustainable or feasible. The MA projected further degradation of ecosystems and the services they provide, particularly as the global population swells to 9.2 billion, emerging economies increase per capita consumption levels, and climate change unfolds. It also warned that further ecosystem deterioration increases the risk that some services, such as freshwater supply, natural hazard regulation, and wild foods, may cross a threshold after which they abruptly and possibly irreversibly decline.

## 2.2 Linking Ecosystem Services and Businesses

These trends matter to companies because the global degradation of ecosystems and the services they provide threaten to alter the landscape in which business operates. Businesses impact ecosystems through consumption, pollution, land conversion, and other activities. Businesses also depend on services provided by ecosystems, sometimes free of charge. Companies often fail to make the connection between the health of the ecosystems and the business bottom line, not fully aware of the extent of their dependence and impact on ecosystems and the possible ramifications.

The ESR is designed to help businesses explicitly make this link and to inform corporate strategy. It is designed for use by a wide range of business sectors and is particularly relevant to the automotive industry for its supplier and customer direct interaction with the ecosystem. At its most formal, the ESR is a structured methodology to help businesses develop strategies to help companies understand their dependence and impact on ecosystems and the resulting business risks and opportunities in a coherent, systematic manner. Many other tools are more suited to handle traditional issues of pollution and natural resource consumption, though most focus on environmental impacts rather than dependence, and on risks rather than business opportunities that emerge from the risks.

The ESR is a unique assessment tool that can complement and strengthen other environmental approaches and assessments by:

- Evaluating corporate activities with regard to the emerging issue of **ecosystem services** rather than more standard issues, such as corporate emissions and effluents.
- Assessing **all** major ecosystem services.
- Assessing a company's impact **and** dependence on ecosystem services, not just its impact.
- Evaluating a company vis-à-vis the environment **and** what people value in the environment.
- Forming **corporate strategy** with information about business risks and opportunities.

However, the ESR does not identify or address every environmental issue: it does not provide an exhaustive inventory list or quantification of a company's total environmental footprint, greenhouse gas emissions, water effluents, or other emissions released into the

environment. The ESR does not take a company's mineral or energy consumption trends but rather addresses a **subset of priority** environmental issues, namely, those arising from a company's dependence and impact on ecosystem services. Moreover, the ESR does not rely on quantitative information or economic valuation, as quantitative information on ecosystem services is often sparse or nonexistent; rather it successfully utilizes qualitative analyses to identify potential business risks and opportunities. The ESR is easily adaptable to examine various depths, depending on the chosen scope, availability of data, and amount of staff involved.

### Key ESR Concepts

- A company **depends** on an ecosystem service if that service functions as an input or if it enables, enhances, or influences environmental conditions required for successful corporate performance.
- A company **impacts** an ecosystem service if the company affects the quantity or quality of the service.
- A company's **priority ecosystem services** are those services on which the company has a high dependence and/or impact and thereby are the most likely sources of business risk or opportunity to the company.
- **Drivers** are factors, natural or man-made, that cause changes in an ecosystem and its ability to supply ecosystem services.

## 2.3 Nissan's ESR for the Automotive Sector

Though perhaps not immediately obvious, mobility—whether private transport for convenient mobility and personal freedom or public and commercial transport of goods for a robust economy—is in fact dependent on and impacts services provided by ecosystems. In the automotive sector, the ecosystem provides freshwater to source biofuels and the hydrogen for fuel cell vehicles, mineral resources for production, and climate regulation through the absorption of carbon dioxide. It also impacts the regulation of natural hazards through the extraction of hydrocarbons in fossil fuels. This presents operational, regulatory, reputational, market and product risks to the industry.

Nissan, in rethinking its green strategy, conducted a Corporate Ecosystem Services Review to explore factors that contribute to sustainable mobility and the relationship between and interactions among ecosystem services and the automotive sector. Through a “rapid assessment” by leading experts and key Nissan managers and later an extensive “desktop analysis,” the ESR identified priority areas for Nissan to consider as a stepping stone to developing its next environmental strategy with the concept of ecosystem services at its core.

### Rapid Assessment

To conduct the ESR, Nissan and the United Nations University Institute of Advanced Studies (UNU-IAS) organized an expert workshop in Palo Alto, California, in August 2008 consisting of a brainstorming session to jointly develop preliminary perspectives on the relevant ecosystem services and a rapid assessment session to prioritize subsequent analyses.

The ESR methodology consisted of five steps: selecting the scope, identifying priority ecosystem services, analyzing trends in priority services, identifying business risks and opportunities, and developing strategies. Various stakeholders with perspectives relevant to every stage of the ESR were brought together, including Nissan executive managers to ensure strategic buy-in and implementation of the ESR results, managers from respective business units, and external experts and UNU-IAS consultants to provide perspectives and conduct ESR-related analyses.

World-renowned MA experts and analysts in the area of biodiversity and ecosystem services, including Professor Harold A. Mooney of Stanford University, Janet Ranganathan of the World Resources Institute, Charles Perrings of Arizona State University, and Christopher Field of Stanford University, offered detailed information on the conditions and trends of ecosystem services. Presentations by Nissan provided internal information sources for those outside the company to fill knowledge gaps. The rapid assessment session was an opportunity to react to each other's perspectives and subsequently prioritize ecosystem services with direct implications for the automotive sector, which were further analyzed as a desktop study.

### Step 1 Scope of the Nissan ESR

The scope of the Nissan ESR covered 10 areas of the value chain, including upstream and downstream aspects of business operations. The implications of ecosystem service trends for key suppliers were highlighted in the upstream analysis, while the downstream study sought insights into the implications of ecosystem service trends for Nissan's customers. The upstream segment specifically looked at mineral mining, fossil fuel sourcing, biofuel sourcing, and materials sourcing of metals and chemicals. Under company operations, the study looked at manufacturing, logistics, and Nissan's office usage; and the downstream review included customer use of Nissan automobiles, road construction and maintenance, and the recycling, disposal, and exports of scrapped cars.

The Nissan ESR did not look at specific business units, product lines, facilities or natural assets owned, or any specific suppliers but rather took a more abstract approach using a holistic framework in considering ecosystem services in the automotive sector. Moreover, there was no geographic focus. While this broad scope posed challenges in data gathering and analysis management, it stimulated creative discussions and enabled ecosystem service sketching at workshops to generate priorities. Afterward, the assessment was refined, filling in the gaps and resolving differences in perspectives for a focused, extensive desktop analysis.

**Table 2. The Value Chain Used for the Nissan ESR**

Upstream:Suppliers	Nissan Operations	Downstream:Customers
<ul style="list-style-type: none"> <li>Mineral mining</li> <li>Materials sourcing (metals, chemicals)</li> <li>Parts production</li> <li>Logistics</li> </ul>	<ul style="list-style-type: none"> <li>Manufacturing (fabrication, painting, thin-coating, assembly)</li> <li>Logistics (ground and ocean transportation)</li> <li>Office usage</li> <li>Sales</li> </ul>	<ul style="list-style-type: none"> <li>Customer use (driving)</li> <li>Fuel consumption</li> <li>Road construction and maintenance</li> <li>Recycling, disposal, and exports of scrapped cars</li> </ul>

Source: Compiled based on WBCSD, Meridian Institute, WRI, The Corporate Ecosystem Service Review, 2008.

**Step 2 Identifying Priority Ecosystem Services**

This step was a screening exercise to evaluate, in a structured yet rapid manner, the company’s dependence and impact on more than 20 ecosystem services to help identify priority services. Priority services are

most likely to be sources of risk or opportunity for the company; put more simply, they are the ones that the company most depends upon or most highly impacts. These became the focus of analysis in subsequent steps. If the company is dependent on a particular ecosystem service, the company faces business risks, such as higher input costs or disruption to its operations. If a company impacts an ecosystem service—either negatively by depleting or degrading it or positively by supplying or enhancing it—this has reputational and regulatory implications for the company.

For this step, there is a need for a company to understand its dependence and impact on each ecosystem service. To identify its priority services, Nissan managers and experts conducted a rapid assessment to determine the level of dependence and impact on each ecosystem

**Table 3. Ecosystem Services Dependence and Impact Matrix**

Ecosystem Services	Upstream : Suppliers		Nissan Operations		Downstream : Customers		
	Dependence	Impact	Dependence	Impact	Dependence	Impact	
Provisioning	Food	●					
	Fiber		●				
	Biomass fuel		●			●	
	Freshwater	●	●	●	●	●	●
	Genetic resources		●				
	Biochemicals, natural medicines and pharmaceuticals		●				
Regulating	Air quality regulation		●		●	●	
	Climate regulation		●		●	●	
	Water regulation		●				
	Erosion regulation		●			●	
	Water purification and waste treatment	●	●		●	●	●
	Disease regulation		●				●
	Pest regulation		●				●
	Pollination		●				
	Natural hazard regulation				●		●
	Cultural	Recreation and Ecotourism		●		●	●
Ethical values			●		●	●	
Supporting	Nutrient cycling		●				
	Primary production						
Water cycling							

Source: Compiled based on WBCSD, Meridian Institute, WRI, The Corporate Ecosystem Service Review, 2008.

service. Participants were asked to rate the dependence and impact and provide accompanying comments and reasoning for their ratings in the following dependence and impact matrix adapted for Nissan.

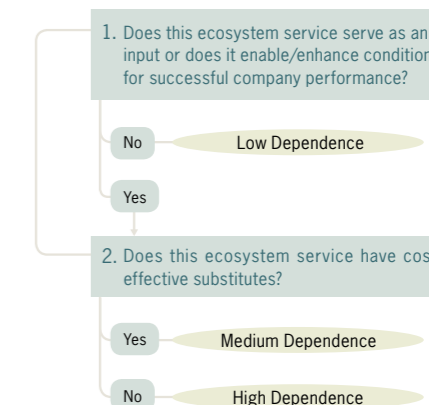
Though qualitative and quick, the ESR questionnaire enables managers and experts to conduct a dependence and impact assessment in a structured manner using just five questions and enhances the likelihood of uncovering overlooked dependencies and impacts.

**Evaluating Dependence**

To evaluate whether Nissan was dependent on an ecosystem service and by how much, two questions were asked for each ecosystem service. The first was, “Does this ecosystem service serve as an input or does it enable/enhance conditions for successful company performance?” If the ecosystem service is not an input or does not enhance or influence environmental conditions required for successful corporate performance, the company has a low dependence on that service. If the answer to the first question was yes, a second question was asked: “Does this ecosystem service have cost-effective substitutes?” The extent to which the company is dependent depends on whether the service has a cost-effective substitute. If there is such a substitute, the company has medium dependence; if there is no substitute, the company is highly dependent on that service.

Answering yes to the first question and no to the second question indicates that the company’s dependence upon the ecosystem service is high. Answering yes to both questions indicates medium dependence. Answering no to the first question indicates low or no dependence on the ecosystem service.

**Figure 3. Questions for Evaluating Dependence**



Source: Compiled based on WBCSD, Meridian Institute, WRI, The Corporate Ecosystem Service Review, 2008.

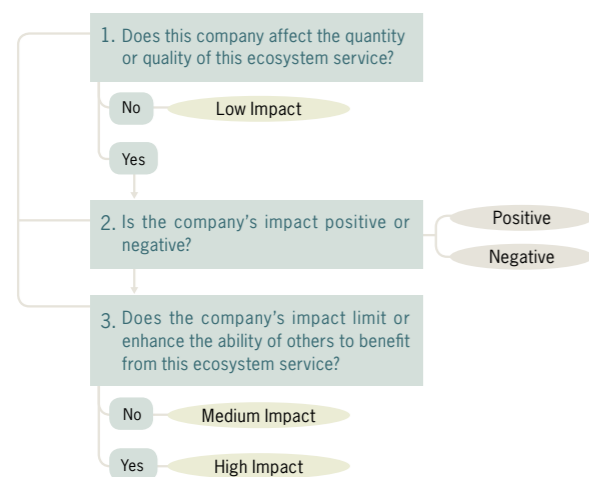
**Evaluating Impact**

To determine whether Nissan impacts an ecosystem service and by how much, three questions were asked. The first was: “Does the company affect the quantity or quality of this ecosystem service?” If the company does not affect the quantity or quality of that ecosystem service, Nissan has a low impact on that service. If yes, a second question was asked to determine the extent of the impact: “Is the company’s impact positive or negative?” The impact is positive if the company increases the quantity or quality of the ecosystem service; negative if it decreases the quantity or quality. Further, for items whose answer was yes to the first question, a third question was asked: “Does the company’s impact limit or enhance the ability of others to benefit from this ecosystem service?” The extent to which the company impacts an ecosystem service is determined based on whether it limits or enhances the ability of others to benefit from that service. This also determines whether the company faces a business risk or opportunity. If the company does not limit or enhance the ability of others to benefit, it has a medium impact; if it does limit or enhance, the company has a high impact on that service.

Answering yes to the first and third questions indicates the company’s impact on the ecosystem service is high. Answering yes to the first question and no to the third question indicates medium impact. Answering no to the first question indicates that the company’s impact is low or negligible.



**Figure 4. Questions for Evaluating Impact**



Source: Compiled based on WBCSD, Meridian Institute, WRI, The Corporate Ecosystem Service Review, 2008.

### Priority Ecosystem Services

Fifteen participants, including Nissan managers, MA experts, and UNU-IAS researchers, each completed a dependence and impact assessment for 10 value chain areas to identify priority ecosystem services. Each assessment matrix was tallied to create a dependence and impact summary matrix. An ecosystem service received a score if 5 out of 15 respondents identified a particular ecosystem service to have a high, medium, or low dependency or positive/negative impact. For example, freshwater received a “high impact” score when 5 or more persons assessed that the automotive sector negatively impacts freshwater service to source biofuels. The assessments were tallied to create a summary matrix.

In accordance with the ESR guideline, top-tier services—that is, those that scored high in categories of both dependence and impact—were identified to have the most priority. Second-tier services were those high in one category and medium in the other. And third-tier services were those high in one category and low in the other. Negative impacts were prioritized over positive. Those with low scores in both categories were not considered priority services.

Based on this assessment, the following seven ecosystem services were selected as priorities for consideration for Nissan and the broader automotive sector:

- **Freshwater**

All 10 areas examined in the assessment noted freshwater as a priority. From “well to wheel,” or oil extraction to vehicle operation, the automotive sector significantly depends upon access to water. This can have a negative impact on the quantity of freshwater by depleting this valuable and finite resource.

- **Air quality regulation**

The automotive sector strongly impacts air quality regulation along the entire value chain, from fossil fuel sourcing to manufacturing, logistics, and finally customer automobile use.

- **Climate regulation**

Greenhouse gases and aerosols emitted into the atmosphere largely through fossil fuels, biofuels, and material sourcing, as well as through company operations and customer automobile use, all potentially influence the global climate. (Biofuel production is dependent on climatic and weather conditions and in part also absorbs greenhouse gases and aerosols).

- **Water regulation**

Mineral mining and fossil fuel sourcing impact the water storage potential in an ecosystem or landscape. Biofuel production farms depend on their surrounding ecosystems to regulate water runoff, control floods, and recharge aquifers.

- **Erosion regulation**

Fossil fuel, biofuel, and material sourcing and mineral mining all significantly negatively impact vegetation and soil retention. Customer automobile use and road construction indirectly impact erosion regulation, as vegetation covers are cleared for infrastructure development.

- **Water purification and treatment**

The automotive sector is highly dependent on freshwater and thus naturally dependent on the ability of ecosystems to filter and decompose organic wastes and pollutants in water.

- **Natural hazard regulation**

The ability to regulate natural hazards can be highly impacted by society’s infrastructure development choices. For example, filling in coastal wetlands to develop scenic ocean-view roads may make the area

and those depending on this infrastructure vulnerable to coastal hazards. Fossil fuel and mineral extraction, often in very difficult terrains, opens up the possibility of numerous man-made environmental risks and could undermine nature’s ability to mitigate climatic change, leading to increases in regional rainfall or absence of expected rain in other areas.

Though not explicitly mentioned in these seven ecosystem services, changes in ecosystems have an impact on the biodiversity inherent in these ecosystems.

To understand the full implications of these seven priority ecosystem services for the mobility sector, the next section expands on them, focusing specifically on the following three business areas:

- (1) Energy sourcing
- (2) Mineral and material sourcing
- (3) Water usage