



**A Global Strategy  
for Ecologically Sustainable Transport  
and other Linear Infrastructure**

**Paris, France  
December 2020**

# A Global Strategy for Ecologically Sustainable Transport and other Linear Infrastructure

Supported by



**IENE**  
Infrastructure and Ecology  
Network Europe



**ANET**  
AUSTRALASIAN NETWORK FOR ECOLOGY & TRANSPORTATION



**ACLE**  
African Conference for Linear  
Infrastructure & Ecology



**ICOET**



**WWF**



**IUCN**

CONNECTIVITY  
CONSERVATION  
Specialist  
Group



**WCPA**  
WORLD COMMISSION  
ON PROTECTED AREAS



Published by:

Copyright ©IENE 2020, All rights reserved

Fondation pour la recherche sur la biodiversité  
(FRB), IENE Executive Secretariat

195 Rue Saint-Jacques, 75005, Paris, FRANCE

Contact IENE: [info@iene.info](mailto:info@iene.info)

Website: <http://www.iene.info>

ISBN: 979-10-91015-53-0

Suggested citation: Georgiadis L. (Coord.), 2020. A Global Strategy for Ecologically Sustainable Transport and other Linear Infrastructure. IENE, ICOET, ANET, ACLIE, WWF, IUCN, Paris, France. P. 24

Cover photo: Tunnels in Egnatia Motorway constructed towards securing connectivity for brown bear (*Ursus arctos*) population in Greece (© L. Georgiadis)

## **Preface**

The current Global Strategy for Ecologically Sustainable Transport and other Linear Infrastructure primarily sets up the objectives and principles for governments and organizations for mainstreaming biodiversity and ecological connectivity on transport infrastructure development. Additionally, it addresses the overall framework of stakeholders who must be engaged as key players in:

- launching proactive policies,
- establishing appropriate legal frameworks,
- supporting better planning,
- promoting multi-sector cooperation, and
- encouraging innovative science-based solutions.

We consider this as a living document as future versions may integrate additional elements with regards to governance, policy, and financing, in the attempt to develop a common comprehensive language and grounds for cooperation.

This “Global Strategy” has been developed by an international working group coordinated by IENE and supported by an international coalition formed from the international conferences on transport and ecology and conservation organisations as IENE, ICOET, ANET, ACLIE, WWF and IUCN. The working group is drawn from global experts in transport and ecology and aims to work towards finding a ‘win-win’ solution for securing mainstreaming biodiversity and ecological connectivity and avoiding, mitigating, or compensating ecosystems’ fragmentation during transport infrastructure development or adaptation.

This Strategy builds upon five years of development of the guidelines “International Guidance for Ecologically - Friendly Linear Infrastructure (IGELI)” initiated at the ICOET 2015 conference in North Carolina, USA. IGELI was an international debate with experts from all over the world continued during workshops held at the international conferences of IENE (Lyon, France, 2016 and Eindhoven, Holland, 2018), ICOET (Salt Lake City, USA, 2017 and Sacramento, USA, 2019), IUCN (Hawaii, USA, 2016) and ACLIE (Kruger National Park, South Africa, 2019). Summarising the Decision 14/3 on mainstreaming of biodiversity in the energy and mining, infrastructure, manufacturing, and processing sectors (CBD/COP/DEC/14/3/30 November 2018) of 14th COP CBD (Sharm El Sheikh, Egypt, Nov 2018) (*Convention on Biological Diversity 2018*), the international coalition of the working group, initiated to promote the Strategy at the CBD COP 15 in China.

We hope, this Strategy provides a useful tool and roadmap for promoting the urgent need of supporting biodiversity conservation and securing ecological connectivity at all scales of governance, policies, planning and implementation of transport projects internationally. The creation of an **International Observatory for monitoring the fragmentation status globally** as an important threat for biodiversity loss is proposed as a common ambition of the working group members and their organizations.

## Contents

Preface .....	3
1. INTRODUCTION .....	5
2. CHALLENGES ON BIODIVERSITY FRIENDLY TRANSPORT AND OTHER LINEAR INFRASTRUCTURE	6
2.1 Impacts on biodiversity and ecosystems due to TLI .....	6
2.2 Basic concepts and challenges to address in ecologically sustainable TLI.....	7
3. THE GLOBAL NEED OF MAINSTREAMING BIODIVERSITY ON TLI DEVELOPMENT.....	8
4. AIM, OBJECTIVES AND PRINCIPLES OF THE GLOBAL STRATEGY.....	10
4.1 Aim and objectives of the Global Strategy.....	10
4.2 Definition of Sustainable TLI and its targets.....	10
4.3 The basic Principles of Sustainable TLI.....	11
5. THE ACTION PLAN: TO WORK TOGETHER.....	12
5.1. The stakeholders, their roles, actions and outputs of four levels of TLI development.....	12
A. POLICY AND STRATEGY LEVEL.....	14
B. THE LEVEL OF PLANNING AND ENVIRONMENTAL IMPACT ASSESSMENT.....	17
C. IMPLEMENTATION AND MANAGEMENT LEVEL .....	19
D. LEVEL OF EDUCATION, AWARENESS, CONSULTATION AND COMMUNICATION.....	20
5.2 Implementation, follow up and funding of the Action Plan of the Global Strategy.....	21
6. BIBLIOGRAPHY.....	22
AUTHORS.....	24



## 1. INTRODUCTION

The demand for Transport and other Linear Infrastructure<sup>1</sup> (TLI) has increased globally, while the loss to biodiversity accelerates; this creates conflict between economic development and nature conservation. The upcoming construction of TLI is translated as a status of “global infrastructure tsunami” (Laurance 2018) in the coming decades: currently there are 64 million km of paved roads on the planet (enough for 83 round-trips to the moon), with an additional 25 million km planned for construction by 2050 (Dulac 2013). Society and the transport sector are facing major challenges: “Biodiversity is deteriorating at a rate that is already a global and generational threat to human well-beings”, whilst 75% of the terrestrial environment, 40% of the marine environment and 50% of streams manifest severe impacts of degradation (IPBES 2019). Earth’s overall terrestrial surface is fragmented into ~600,000 patches, of which more than half are surfaces that cover less than 1 km<sup>2</sup> with only 7% covering areas larger than 100 km<sup>2</sup>. Consequently, global preservation of ecologically valuable roadless areas is not guaranteed (Ibisch et al 2016, IENE 2014) while just 10% of the global terrestrial protected area network is structurally connected via intact land (Ward et al 2020). On the other hand, use of electricity requires an effective distribution system between the centres of production and consumption via a dense net of power lines. It is estimated that there are over 65 million km of medium- and high-voltage power lines in across the world, with this figure rising at a rate of 5% each year (Jenkins et al, 2010). The impact of these Linear Infrastructure (LI) includes death through collision and electrocution of millions of birds and other animals, such as monkeys and bats, as well as transforming their habitats. Some estimates for annual bird mortalities caused by power lines exceed- 100 million in North America (Loss et al, 2014) and are several million more in Europe (Prinsen et al, 2011).

Ensuring that infrastructure development is sustainable and safe for both humans and biodiversity is a challenge, requiring urgent action at multiple scales by a wide range of public and private sectors for all LTI. Currently, relevant organisations working on design, construction, operation and maintenance of transportation, energy, water and other public undertakings are providing remarkable services to society. Stakeholders hold the key to the necessary development, with civil engineers, environmentalists, landscape planners, financial professionals, decision makers and politicians, all part of this service and process. Therefore, all ‘actors’ have a duty to contribute to the 2030 Agenda for Sustainable Development, established by the United Nations (UN) member states. This includes reaching the targets set to address climate change, improving biodiversity and protecting and safeguarding the world’s natural heritage.

The “Global Strategy for Ecologically Sustainable Transport and other Linear Infrastructure”, here after the “Global Strategy”, takes into account urgent actions required under the framework from both the UN’s Sustainable Development Goals (SDG) and Aichi Targets of the Convention of Biological Diversity (CBD) and follows the need to mainstream biodiversity in energy, mining and infrastructure development, as noted in the Decision 14/3 by the conference of the parties to the CBD adopted in their fourteenth meeting (Convention on Biological Diversity, 2018). The Global Strategy, analyses challenges, sets goals, objectives, and principles and with the joined Action Plan will be presented to the CBD and promoted at the CBD COP 15 in China.

The -Global Strategy- seeks to contribute to joining forces between transport and other forms of linear infrastructure towards realising our vision for a sustainable future. Consequently, our Global Strategy intends to address the following:

*“In 2050, Transport and other Linear Infrastructure are designed, constructed and operated in such a cooperative and transparent way, that, transportation of people, goods, products and energy services, supports the prosperity of human societies, the maintenance of local cultures and the healthy development of economies; without damaging the cohesion of natural ecosystems, the survival of all the species and the quality of landscape, water, air and beauty of our planet”.*

<sup>1</sup> Roads, railways, navigable channels, waterways, canals, power lines and pipelines.

## 2. CHALLENGES ON BIODIVERSITY FRIENDLY TRANSPORT AND OTHER LINEAR INFRASTRUCTURE

### 2.1. Impacts on biodiversity and ecosystems due to TLI

The dispersal of organisms considered the most important aspect of life after survival and reproduction (Hamblen 2004), while nature has the right to be protected (Chapron et al 2019) and TLI provide crucial services for people’s mobility needs and the transportation of energy and goods. TLI are vital for the prosperity of societies. However, alongside changes to agriculture and urban expansion, TLI has both primary and secondary effects on nature (Van der Ree et al 2015, Luell et al 2003; Table 1). One of the primary impacts is fragmentation of natural ecosystems (Van der Ree et al 2015, Forman et al 2003, Sherwood et al 2003, Trocme et al 2002, Canters et al 1997), which influences biodiversity decline and species evolutionary perspectives worldwide (Brady & Richardson 2017). Additional impacts include direct habitat loss and disturbances caused by noise, light, or pollution, which have profound and long-lasting impact that extends well away from the immediate footprint of the development. Similarly, other LI, such as power lines, are a major cause of unnatural deaths for many bird species worldwide due to electrocution and collision (Page-Nicholson et al 2019, Shaw et al 2017, Shaw 2013, Van Rooyen C.S. 2004)

Table 1: Primary and secondary effects on biodiversity due to TLI (based on Luell et al 2003)

Primary effects on biodiversity	
1	<u>Loss of wildlife habitats</u> , as considerable surface areas are occupied by TLI structures. Parallel supportive infrastructure (such as operation facilities and logistics) further creates a wider zone of occupation in natural areas. For several threatened species, and especially those with small populations, the combination of habitat fragmentation and loss is a main cause for their decline.
2	<u>Barrier effects</u> for both local and migratory species populations negatively influence their natural movements. This increases genetic isolation, and can contribute to extinction of endangered species.
3	<u>Faunal casualties</u> resulting from collisions between vehicles and wildlife, electrocutions related to electrical infrastructure and bird collisions with overhead lines. This has multiple costs, primarily to humans (deaths and injuries, damage to vehicles and hardware, medical treatment, policy, and patrol maintenance) as well as impacts on animal populations.
4	<u>Disturbance and loss of habitat quality due to noise, light and pollution</u> resulting from TLI and its associated users influence zones on a wider scale than the land they occupy.
5	The ecological function and the value of habitats related to infrastructure such as verges, green or drainage areas, is rarely considered. These habitats are important refuges for numerous flora and fauna species; however, they can be ecological traps and be causes for roadkill, or also spread of Invasive Alien Species.
Secondary effects on biodiversity	
1	<u>Resulting changes in the landscape</u> are often not addressed with the development of a TLI; for example, with a new road, urbanisation, human settlements, local access roads are often secondary developments. These are major land use changes.
2	TLI, whilst improving access and improved livelihoods, often create <u>disturbance</u> to areas previously inaccessible. Hunting, poaching and tourism are examples of activities that access otherwise undisturbed wildlife habitats.
3	<u>Negative landscape ecology perspectives</u> over extended periods and broader geographical scales require permanent TLI interventions, especially in sensitive, natural landscapes; this can determine an overall future framework of irreversible impacts.

## 2.2. Basic concepts and challenges to address in ecologically sustainable TLI

Towards understanding the impacts of TLI on biodiversity and especially on habitat fragmentation, the following concepts (*Table 2*) are used as a requirement to address and respond to the challenges of securing ecological connectivity (*Georgiadis et al 2018a*):

1. Problem: Genetic isolation and wildlife mortality;
2. Cause: Habitat fragmentation and land degradation;
3. Aim: Ecological and landscape connectivity;
4. Objective: Sustainability;
5. Conflict: Green and grey infrastructure; and,
6. Solution: Avoidance and mitigation as the main solutions.

These concepts are the crucial key topics to be addressed when developing LTI projects, to minimise their impact on ecosystem and landscape cohesion.

*Table 2: Basic concepts for ecological connectivity (based on Georgiadis et al 2018a)*

	<b>Ecological connectivity concepts</b>	<b>Logical framework concepts</b>	<b>Description</b>
1	<b><i>Genetic isolation and wildlife mortality</i></b>	<b><i>Problem</i></b>	The main environmental challenges related to LTI development are: genetic isolation, wildlife mortality and the loss of ecosystem functions which can cause significant changes in habitats, thus making it impossible for the original community of species can persist.
2	<b><i>Habitat fragmentation</i></b>	<b><i>Cause of the problems</i></b>	The lack of genetic exchange is caused by the habitat fragmentation on both terrestrial and aquatic ecosystems.
3	<b><i>Securing the ecological connectivity</i></b>	<b><i>Aim</i></b>	The main aim is to secure the ecological connectivity in important natural areas, as species' basic habitats or ecological corridors when they are intersected by TLI.
4	<b><i>Sustainability</i></b>	<b><i>Objective</i></b>	Sustainability and quality, must be achieved for three different perspectives: Social, Environmental and Economic.
5	<b><i>Green and Grey infrastructure</i></b>	<b><i>Crossing point and conflict areas</i></b>	Adopting the concepts of Green Infrastructure, the Natural Capital and the Ecosystem Services and identifying the conflicts in the main "crossing points" that Grey - Infrastructure such as TLI pass through Green Infrastructure/ natural areas.
6	<b><i>The hierarchy of priorities: Avoidance - Mitigation – Compensation</i></b>	<b><i>Solution</i></b>	The achievement of sustainable coexistence of Green and Grey Infrastructure must focus on resolving conflict through specific measures following the hierarchy of priorities of Avoidance - Mitigation – Compensation.



### 3. THE GLOBAL NEED OF MAINSTREAMING BIODIVERSITY ON TLI DEVELOPMENT

Addressing conflict between TLI and nature conservation is especially important where the last large tracts of unfragmented land with high biodiversity remain, such as in many African countries (*Laurance et al 2017*). Recent projects for road building or road re-opening in South America, such as, the Brazilian Amazon (*www.theguardian.com 2018*), Iguassu National Park in Argentina (*www.wwf.org.uk 2013*) and the Peruvian Amazon (*www.news.mongabay.com 2019*), are examples that illustrate this duality.

In 2018 mainstreaming biodiversity in energy, mining, and infrastructure development, has been a major goal in the framework of the CBD to achieve Aichi Biodiversity Targets by 2020 (*Convention on Biological Diversity 2018*). The desired aim of Aichi Biodiversity Target 5 that, by 2020, the rate of loss of all natural habitats and degradation and fragmentation is significantly reduced, didn't achieved. Additionally, Aichi Target 11, states that, achieving well-connected systems of protected areas is also vital for conservation (*Hilty et al 2020*) for which initiatives exist to develop corridors and transboundary parks, but there is still not sufficient connection and specific targets or comprehensive indicators of connectivity are not yet available. Therefore, there is an urgent need for action. According to Global Biodiversity Outlook 5 (*Secretariat of the Convention on Biological Diversity 2020*), loss, degradation and fragmentation of habitats remains high in forest and other biomes, especially in the most biodiversity-rich ecosystems in tropical regions; wilderness areas and global wetlands continue to decline; fragmentation of rivers remains a critical threat to freshwater.

Furthermore, towards meeting the requirements for the CBD 2050 Vision for Biodiversity of the Strategic Plan for Biodiversity 2011-2020 "Living in harmony with nature", the Global Biodiversity Outlook 5 clarified eight distinct but closely inter-related aspects of transitions needed in particular realms and areas of human activity. The selection of these areas of transition is largely based on the 'nexus' approach outlined in the IPBES Global Assessment (*IPBES 2019*) with the addition of the biodiversity-inclusive One Health transition in view of the global relevance of the links between nature and health highlighted by the COVID-19 pandemic.

One of the required transitions is "The sustainable cities and infrastructure transition" aiming on Deploying Green Infrastructure and making space for nature within built landscapes to improve the health and quality of life for citizens and to reduce the environmental footprint of cities and infrastructure. One of the four key components of the transition states clearly to **reflect biodiversity considerations in the planning and development of infrastructure investments**, such as the design and management of transportation systems, and other linear infrastructure, through processes such as biodiversity-inclusive environmental assessments and large-scale zoning to avoid the most vulnerable areas for biodiversity, and application of measures to preserve ecological connectivity, for example through overpasses, underpasses and green infrastructure.

At EU level, the coherence of Natura 2000 Network protected areas is foreseen according Article 10 of the EU Habitats Directive. This is a crucial obligation for the European states towards achieving both the Aichi targets 5 and 11. Additionally, In 2019, an EU guidance document was issued on integrating ecosystems and their services for decision-making (*European Commission, 2019*) towards facilitating the formation of appropriate policies on mainstreaming biodiversity in all development sectors (regional or cohesion policies, climate change and environment polices, disaster risk management policies, the EU water policy, energy infrastructure, EU transport policy).

To address the before mentioned "global concerns", there is an urgent need to tackle habitat loss, fragmentation and degradation and mainstreaming biodiversity with TLI development from the decision and planning level until the construction, operation and maintenance in practice. Towards transforming the "global thinking" to "local acting", the main elements of the Global Strategy include:

- The aims, objectives, principles, and an overall framework of stakeholder groups that must be involved as key players for development of ecologically sustainable TLI (see Section 4); and,

- An outline Action Plan that includes a concrete direction of actions towards achieving concrete outputs in the next decade (2020-2030) (see Section 5).

The main approach of the Global Strategy is “to join forces” of different target groups at all levels of TLI development; these include the main stakeholders such as, the policy makers, agencies/authorities working in design, construction, operations and maintenance of TLI, as well as government ministerial staff, and/or private or public TLI companies.

The development of the Global Strategy considered the relevant actions required to engage stakeholders in projects and plans connected with biodiversity, nature conservation, business and TLI development following a comprehensive search of the available literature and of several online sources (*AccountAbility 2015, BSR 2019, Cariani in ENAIP Veneto CERlecon project – CE119, Durham et al 2014, Jeffery 2009, GIB 2017, International Finance Corporation of the World Bank 2017, Krick et al 2005, Leal and Brandli 2016, MacNicol et al 2014*).

## 4. AIM, OBJECTIVES AND PRINCIPLES OF THE GLOBAL STRATEGY

### 4.1. Aim and objectives of the Global Strategy

The aim of the Global Strategy is to promote and enhance the mainstreaming of biodiversity and ecological connectivity into TLI development and to define a roadmap on effective engagement of all the different stakeholders as important and crucial players in developing sustainable TLI globally. The main objectives to address this aim are:

- Establishing appropriate legal frameworks and regulatory requirements at international, regional and national levels;
- Establishing ecosystem approaches based on the uniqueness of each landscape and habitat affected by TLI;
- Encouraging better planning and innovative science-based solutions on resilient, high quality and environmentally sustainable TLI;
- Promoting multi-sector cooperation;
- Launching proactive policies at international, cross-border and national levels;
- Engaging with the civil society and the broader public; and,
- Securing sufficient and responsible funding as sustainable investment in TLI.

### 4.2. Definition of Sustainable TLI and its targets

Sustainable TLI can be defined (based on definition of environmentally friendly transport of the Protocol on Sustainable Transport, *Carpathian Convention 2014*) as TLI that:

- Preserves the integrity of biodiversity at the genetic, species and ecosystem;
- Avoids any negative impact on land use, landscape ecosystems and species;
- Mitigates any residual effects on biodiversity and habitats;
- Secures both transportation and ecological connectivity, while reducing fragmentation of the natural habitats and isolation of human societies;
- Reduces pollution, noise, light, emissions and waste, thus minimising their impact on weather and climate;
- Is safe, adaptable, and resilient to extreme weather events and other risks;
- Uses renewable resources at, or below, their rates of generation;
- Uses non-renewable resources at, or below, the rates of development of renewable substitutes;
- Is based on multi-level governance and stakeholder engagement;
- Promotes economic development, social progress, and eliminates poverty along its corridor in developing countries, including respect for local societies and their cultures in areas intersected by its alignment; and,
- Ensures people feel safe and enjoy the aesthetic experience of beautiful sceneries, whilst integrating TLI into the landscapes.

### 4.3. The basic Principles of Sustainable TLI

The basic Principles for Sustainable TLI are outlined in *Table 3* below:

*Table 3: International Principles for Sustainable TLI (based on Georgiadis et al 2018b, Hanoi Forum 2017: [www.gms-eoc.org](http://www.gms-eoc.org), Carpathian Convention 2003)*

International Principles for Sustainable TLI	
1	<b>Strong policy and legal framework:</b> Safeguarding landscape connectivity as a primary concern for any project scale, establishment and strengthening of a policy and legal framework of regulatory requirements for sustainable TLI development is necessary.
2	<b>Strategic planning:</b> Any major TLI should be based on an overall strategic plan, and designed and developed to guarantee ecological fluxes and well-connected wildlife populations before any implementation and funding decision is made. The “Mitigation Hierarchy” of ‘Avoidance – Mitigation – Compensation’ should also be implemented.
3	<b>Ecosystem approach:</b> TLI projects should combine habitat quality with healthy ecosystem functioning based on the “Precautionary Principle”. The value of Natural Capital and ecosystems services should be included along with projects that acknowledge cultural diversity, as an integral component of ecosystems ( <a href="http://www.cbd.int">www.cbd.int</a> ).
4	<b>Any case is a unique case:</b> Each TLI project is site-and species-specific and is therefore unique. Mitigation should be based on scientific and best available local knowledge without “copy and paste” from other projects.
5	<b>Multi-disciplinary and cross-sector cooperation:</b> To ensure integration and coordination, the establishment of multi-level governance and stakeholder engagement, with multi-disciplinary co-operation amongst different professionals (such as engineers, policy makers, economists, ecologists and environmentalists) as well as cross-ministerial agencies (such as, nature conservation, transportation, finances) should be applied.
6	<b>Stakeholder involvement and public participation:</b> Involvement of civil society and all the relevant stakeholders in the development of TLI projects.
7	<b>Responsible polluter pays principle:</b> Implementation of the “polluter pays principle” where the integration of environmental consideration is responsible for TLI investments, after clarifying the ethical and transparency concerns; this should include concrete mitigation measures from the onset of the TLI planning phase, until the tendering and contracting, and finally to the building and operating phases.
8	<b>Long life effective maintenance:</b> Inclusion of TLI maintaining mitigation measures in the budget for the life-cycle of the operation.
9	<b>Resilience to climate change:</b> TLI should be planned or adapted with consideration for their resilience to natural disasters and risks, associated with extreme weather events and climate change. This is especially the case for TLI, where responses to stronger and intense precipitation with larger bridges and culverts servicing both hydraulic and ecological connectivity purposes is a critical requirement.
10	<b>Adaptable infrastructure habitats:</b> Habitats related to TLI should be planned and managed in a manner that fulfils their potential as positive biodiversity refuges and ecological corridors.
11	<b>Environmental supervision:</b> Inclusion of environmental supervision that monitors the effectiveness of TLI features and the habitat and wildlife populations in all phases of programmes, plans and projects; this is within the Strategic Environmental Assessment, Environmental Impact Assessment to the design of full operation and maintenance.
12	<b>Culture of learning:</b> Establishment of a culture of learning to develop and support continuous evaluation and exchange of knowledge and experience between the interested, relevant and authorised organisations and state services.

## 5. THE ACTION PLAN: TO WORK TOGETHER

### 5.1. The stakeholders: their roles, actions, and outputs for the four levels of TLI development

Towards achieving the aim of the Global Strategy, it is necessary to define the crucial players and the role that each of them has to play crossing a multilateral level of cooperation: this includes the high, political level of recognising the crucial problems and taking the right policy and planning decisions, to the practical implementation of solutions at local, regional level. An indicative example of this is, the 15-year-long national defragmentation project in the Netherlands finalised in 2018 (<https://www.mjpo.nl>, IENE 2018).

All players comprise a broad spectrum of stakeholders that participate, partially or decisively and in different ways, to TLI development, from the level of Strategies and Plans for large programmes at a national level to concrete projects in-practice during their operation. Engagement of all necessary stakeholders during the initial strategic planning phase right, provides added value to the best proactive approach, minimising possible gaps in communication and errors during implementation. At the same time, correct stakeholder involvement maximises the effectiveness of the proposed solutions to address technical, social and environmental problems, which, in most of the cases, transform the economic base and increase final costs. Mapping of the stakeholder engagement is therefore, essential to achieve TLI sustainability and development on a trilateral level; social, economic and environmental (Georgiadis et al 2019).

The Action Plan of the Global Strategy describes, (i) all stakeholders and their actions and inputs that can contribute to the recognition of the problems, (ii) strategic decisions that secures political sustainability; and, (iii) plans to implement TLI sustainable development at a local, regional level.

Identification of relevant stakeholders involved in the design and development of the Action Plan can be described in three stages:

#### Stage 1: Scoping and mapping of stakeholders

One of the first steps in project planning, either on preparation of a National or Local TLI Programme, is the stakeholder identification and understanding what constitutes a stakeholder. Loosely defined, a stakeholder is a person or group of people who can affect, or be affected, by a given project. Stakeholders can be individuals working on a project, groups of people or organisations, or even segments of a population (Durham et al 2014, International Finance Corporation of the World Bank 2007, Krick et al 2005, MacNicol et al 2014).

There are many ways to identify stakeholders for a project, however, it should be undertaken in a methodical and logical way to ensure that stakeholders are not easily omitted. This may be done by examining stakeholders organisationally, geographically, or through involvement with various project phases or outcomes.

#### Stage 2: Assessing, analysing and prioritising stakeholders

An outcome of identifying stakeholders should be a project stakeholder register, whereby names, contact information, titles, organisations, and other pertinent information of all stakeholders is captured. This register will form part of a Stakeholder Management Database, whereby each stakeholder's representation is analysed. This includes:

1. The credibility connected with the perceived quality and validity of the stakeholder's engagement;
2. The relevance connected with the usefulness of the engagement process and its outcomes;
3. The legitimacy connected with the perceived fairness and balance of the stakeholder engagement process, particularly important in cases where conflicts may occur; and,
4. The responsibility on achieving sustainability on TLI development.

### Stage 3. Understanding the roles of the Stakeholders

Once all stakeholder information has been captured into the database, strategies for stakeholder management are developed; these should be geared toward maintaining support from those who are in favour of the project while winning over those opposed or, at least, mitigating the risks they may present. These can loosely be identified as four stakeholder roles:

1. Informative: Stakeholders who have little interest but may be affected by the strategy. It is important to assist them in understanding the problems and promoting potential solutions;
2. Consultancy: Stakeholders with high interest, low influence but they are supportive;
3. Involvement: Stakeholders that work partially or directly with interested third parties and it is, therefore, necessary to ensure their concerns and aspirations are understood, considered and, where appropriate, incorporated into decision making; and,
4. Fundamentally collaborated: Stakeholders who work in partnership with relevant aspects and phases of a TLI development process from the decision-making and planning stages through to the implementation, operation, and maintenance phases of a project.

Understanding the role of a stakeholder is critical, since different stakeholders have differing viewpoints, and may create challenges in achieving consensus. To avoid bilateral conflicts, or dominance of some stakeholders over others, with clear, defined roles are more effective than an effort to engage many stakeholders on a voluntary basis.

The Action Plan with the main stakeholders to be involved for the implementation of the Global Strategy is described in Table 4 with four distinct levels of governance for stakeholder type (*Moç et al 2019*), namely:

- A. Policy and strategy;
- B. Planning and environmental impact assessment;
- C. Implementation and management; and,
- D. Level of education, awareness, consultation and communication.

These levels of governance are further split into four administrative levels following the approach of the Guidelines for an Integrated Approach in the Development and Implementation of National, Subnational and Local Biodiversity Strategies and Action Plans (*Secretariat of the Convention on Biological Diversity, 2017*):

1. International;
2. Continental/Regional;
3. National; and,
4. Local (including states, counties, regions and/or provinces).



Table 4. An Action Plan for stakeholder engagement for the development of Sustainable TLI

**A. POLICY AND STRATEGY LEVEL**

#	STAKEHOLDER	ACTION	Timeframe		EXPECTED OUTPUTS AND RESULTS
			2020-2025	2025-2030	
<b>International</b>					
1	International Conventions: <ul style="list-style-type: none"> <li>• Convention on Biological Diversity</li> <li>• Bonn Convention</li> <li>• Climate Change Convention</li> <li>• Espoo (EIA) Convention</li> <li>• Ballast Water Management (BWM) Convention</li> </ul>	<ul style="list-style-type: none"> <li>• Promote the recognition of fragmentation as a global threat to biodiversity</li> <li>• Mainstream ecological connectivity as a common goal in all environmental and sustainable development policies, specifically TLI development and spatial planning</li> </ul>	X		<ul style="list-style-type: none"> <li>• Amendments to the conventions and decisions for common international goals for mainstreaming biodiversity on TLI development</li> <li>• Established cohesion of ecological connectivity with transportation that is both functional and safe</li> </ul>
2	UNEP – Sustainable Infrastructure Partnership (SIP)	<ul style="list-style-type: none"> <li>• Support for international and national strategies for sustainable TLI</li> <li>• Establish a ‘common language’ for sustainable development of TLI for politicians, investors, financiers, engineers, environmentalists as well as members of the public</li> <li>• Promote a multidisciplinary and cross-sector approach</li> </ul>	X		<ul style="list-style-type: none"> <li>• Recommendations provided to global regional organisations, national governments, investors and TLI planners, constructors and operators</li> <li>• Guidelines, standards and best practices are endorsed by relevant stakeholders</li> </ul>
3	International Forums: <ul style="list-style-type: none"> <li>• High-level Political Forum on Sustainable Development</li> <li>• G20</li> <li>• G77</li> <li>• World Economic Forum</li> <li>• Belt and Road Forum for International Cooperation</li> </ul>	<ul style="list-style-type: none"> <li>• Adopt policies on sustainable development of TLI and transportation of people, foods, goods (materials and products), energy and services</li> <li>• Encourage ‘Business and Biodiversity’ engagement</li> </ul>	X		<ul style="list-style-type: none"> <li>• Policies are adopted on sustainable development of TLI and transportation of people, foods, goods (materials and products), energy and services</li> <li>• “Strong policy and legal frameworks” which support sustainable TLI development are in place</li> </ul>
4	International Organizations for infrastructure development: <ul style="list-style-type: none"> <li>• World Road Association (PIARC)</li> <li>• World Association for Waterborne Transport Infrastructure (PIANC)</li> <li>• International Union of Railways (UIC)</li> <li>• Global Infrastructure Basel (GIB)</li> <li>• Power Line Organizations</li> <li>• Energy utility companies</li> </ul>	<ul style="list-style-type: none"> <li>• Mainstream biodiversity and ecological connectivity in environmental and sustainable development policies and strategies, thereby adopting the “Ecosystem approach” principle</li> </ul>	X	X	<ul style="list-style-type: none"> <li>• International guidelines and standards are adopted on planning, construction, operation and monitoring of TLI development supporting the coherence of both transport and ecological corridors are established</li> </ul>

#	STAKEHOLDER	ACTION	Timeframe		EXPECTED OUTPUTS AND RESULTS
			2020-2025	2025-2030	
5	<p>International Organizations on Nature Conservation:</p> <ul style="list-style-type: none"> <li>• IUCN</li> <li>• WWF-International</li> </ul> <p>Continental networks and conferences on infrastructure and ecology with international activities:</p> <ul style="list-style-type: none"> <li>• ICOET</li> <li>• IENE</li> <li>• ANET</li> <li>• ACLIE</li> <li>• CIBIV</li> </ul>	<p>Each organization/network/conference is encouraged to:</p> <ul style="list-style-type: none"> <li>• Support consultation and policy production on:                             <ul style="list-style-type: none"> <li>- Promoting the “global thinking to local acting”</li> <li>- Translating “local needs to global concerns”</li> </ul> </li> <li>• Cooperate and take initiatives with common actions and synergies</li> <li>• Exchange scientific knowledge and promote effective practical solutions for TLI ecology.</li> </ul>	X	X	<ul style="list-style-type: none"> <li>• Concrete schemes of multidisciplinary and cross-sector cooperation are developed</li> <li>• International guidelines and standards are adopted on planning, designing, construction, operation and monitoring of TLI development supporting the coherence of both transport and ecological corridors are established</li> <li>• Global regional organisations and national governments are advised and guided of new policy and decision-making</li> <li>• TLI and ecology publications, reports and recommendations are available for all stakeholders</li> <li>• Conferences and workshops on TLI and ecology and infrastructure are promoted as platforms of knowledge-exchange, sharing best practices and networking opportunities</li> </ul>
6	<p>International banks:</p> <ul style="list-style-type: none"> <li>• World Bank</li> <li>• Investment banks</li> <li>• International regional banks</li> <li>• European Investment Bank (EIB)</li> <li>• European Bank for Reconstruction &amp; Development (EBRD)</li> <li>• African Development Bank</li> <li>• Asian Development Bank (ADB)</li> <li>• Asian Infrastructure Investment Bank (AIIB)</li> <li>• International Development Bank (IDB)<sup>1</sup></li> </ul>	<ul style="list-style-type: none"> <li>• Support for the precautionary principle when the potential impact of a project on biodiversity is unclear</li> <li>• Support of the “responsible polluter’s pay principle” as part of an ethical framework towards sustainability of infrastructure investments</li> <li>• Budget support of mitigation measures in the planning stage of TLI projects</li> <li>• Support for TLI-biodiversity research projects following the principle of ‘environmental supervision’ in a pre-compensate approach</li> </ul>	X	X	<ul style="list-style-type: none"> <li>• Established international standards for financing sustainable TLI investments are adopted trilaterally (i.e. civil, environmental and economic)</li> <li>• New knowledge systems for ecology and TLI are embraced as a “Culture of Learning” particularly in developing countries. This can include:                             <ul style="list-style-type: none"> <li>- Endangered and new species presence and local conservation status.</li> </ul> </li> <li>• Effective mitigation measures and innovate solutions adapted for local ecology and TLI development</li> <li>• Environmental Impact Assessments (EIA) include biodiversity aspects when a project is to be implemented</li> <li>• Methodology to improve assessment of biodiversity issues in EIAs is improved and effectively applicable at a project level</li> </ul>

#	STAKEHOLDER	ACTION	Timeframe		EXPECTED OUTPUTS AND RESULTS
			2020-2025	2025-2030	
<b>Continental/Regional</b>					
7	<p>Conventions or initiatives in Global Regional scale:</p> <ul style="list-style-type: none"> <li>• Bern Convention in Europe</li> <li>• European Landscape Convention</li> <li>• Carpathian Convention</li> <li>• Alpine Convention</li> <li>• Other bio-regional conventions</li> <li>• Boao Forum for Asia (<a href="http://www.english.boaoforum.org">www.english.boaoforum.org</a>)</li> <li>• Initiative 20x20 in Latin American and Caribbean countries (<a href="http://www.initiative20x20.org">www.initiative20x20.org</a>)</li> <li>• Conventions/initiatives in Africa</li> <li>• Conventions/initiatives in Australia</li> <li>• Other bio-regional conventions and initiatives</li> </ul>	<ul style="list-style-type: none"> <li>• Recognition of fragmentation as a global threat for biodiversity and mainstreaming ecological connectivity as a common goal in all environmental and sustainable development policies and mainly on TLI development and Spatial Planning</li> </ul>	X	X	<ul style="list-style-type: none"> <li>• Amendments of the Conventions and Decision for common international goals on ecological connectivity, mainstreaming biodiversity on TLI development and the cohesion of the protected areas in national and trans-border level</li> </ul>
8	<p>Intergovernmental Regional “Unions”:</p> <ul style="list-style-type: none"> <li>• EU</li> <li>• African Union</li> <li>• Organization of American States</li> <li>• Union of South American Nations</li> <li>• Arab League</li> <li>• The Shanghai Cooperation Organisation</li> <li>• Asia-Pacific Economic Cooperation</li> <li>• Other regional unions</li> </ul>	<ul style="list-style-type: none"> <li>• Recognition of fragmentation as a global threat for biodiversity and mainstreaming ecological connectivity as a common goal in all environmental and sustainable development policies and mainly on TLI development and Spatial Planning</li> <li>• Promoting the Green Infrastructure policy in all development sectors towards investing in the natural capital and perpetuate the natural resources sources for the future generations</li> <li>• Providing appropriate funding for including planning, designing, constructing, operating and maintenance of TLI in the most sustainable way and securing the functional ecological connectivity</li> </ul>	X	X	<ul style="list-style-type: none"> <li>• Decisions (in form of Strategies, Policies, Directives or Regulations) and concrete guidance tools to implement effectively in practice the development of sustainable TLI</li> <li>• Provision of efficient and appropriate funds without “environmental discounts”</li> </ul>
9	<p>Continental Organizations for infrastructure development:</p> <ul style="list-style-type: none"> <li>• CEDR in Europe</li> <li>• PIARC</li> <li>• PIANC</li> <li>• UIC</li> <li>• Power Lines Organizations</li> <li>• Energy utility companies</li> <li>• Other continental organizations</li> </ul>	<ul style="list-style-type: none"> <li>• Mainstreaming biodiversity and ecological connectivity in all their environmental and sustainable development policies and strategies</li> </ul>	X	X	<ul style="list-style-type: none"> <li>• Established International guidelines, standards and forms on planning, designing, construction, operation and monitoring of sustainable TLI development supporting the coherence of both transportation and ecological corridors</li> </ul>

#	STAKEHOLDER	ACTION	Timeframe		EXPECTED OUTPUTS AND RESULTS
			2020-2025	2025-2030	
<b>National</b>					
10	Governments	<ul style="list-style-type: none"> <li>Adopt and enforce international policies and established legal frameworks for TLI and ecology at national and local trans-border levels</li> </ul>	X	X	<ul style="list-style-type: none"> <li>National sectoral policies and strategies are developed</li> <li>Concrete legal frameworks, national master plans and programmes are established</li> <li>National platforms, comprising key experts with multisector backgrounds for systematic policy integration of biodiversity and TLI objectives, are developed</li> </ul>
11	Agencies as: <ul style="list-style-type: none"> <li>Research Centres and Institutes</li> <li>Environmental Agencies</li> <li>Transport and Energy Agencies and Administrations</li> <li>Water Management Agencies</li> <li>Agencies for Development</li> </ul>	<ul style="list-style-type: none"> <li>Support and facilitate the production of knowledge and innovative solutions for TLI and ecology</li> <li>Support and facilitate the development of policies and strategies at a national and regional level</li> </ul>	X	X	<ul style="list-style-type: none"> <li>National and regional sectoral policies and strategies are developed</li> <li>National and Regional master plans and programmes are developed</li> <li>National data bases on ecology and infrastructure are established</li> </ul>
<b>Local</b>					
12	Regions (including counties provinces, states and municipalities)	<ul style="list-style-type: none"> <li>Adopt and enforce international policies for TLI and ecology at national and local trans-border levels</li> </ul>	X	X	<ul style="list-style-type: none"> <li>Regional strategies and master plans are developed</li> <li>Local Action Plans implementing the 'Global Thinking' into 'Local Acting' are established</li> <li>Regional data bases on ecology and infrastructure are developed</li> </ul>

**B. THE LEVEL OF PLANNING AND ENVIRONMENTAL IMPACT ASSESSMENT**

#	STAKEHOLDER	ACTION	Timeframe		EXPECTED OUTPUTS AND RESULTS
			2020-2025	2025-2030	
<b>National</b>					
1	Ministries (to include: transport, infrastructure, environment, development, economy, spatial planning, energy, agriculture, forestry, tourism, water management)	<ul style="list-style-type: none"> <li>Support for appropriate impact assessments in SEAs and EIAs, including ecological connectivity and the climate vulnerability as fundamental environmental aims considering their cumulative effects on TLI</li> <li>Establishment of procurement procedures with clear language and standards for securing the functional connectivity of TLI development</li> <li>Develop sectoral programmes, master plans and projects on sustainable TLI at national and local trans-border levels</li> <li>Implement the Espoo (EIA) Convention in case of cross-border TLI projects in order to adverse environmental impact across boundaries</li> </ul>	X	X	<ul style="list-style-type: none"> <li>Sectoral programmes, master plans are established at national and local trans-border levels</li> <li>SEAs and EIAs recognise fragmentation in their environmental impacts' assessment followed by monitoring until the operation and maintenance</li> <li>Integrated plans and designs of concrete TLI projects at local levels are produced</li> </ul>

#	STAKEHOLDER	ACTION	Timeframe		EXPECTED OUTPUTS AND RESULTS
			2020-2025	2025-2030	
<b>Local</b>					
2	<ul style="list-style-type: none"> <li>Local Regional authorities:                             <ul style="list-style-type: none"> <li>- Regions (or counties and provinces)</li> <li>- Municipalities</li> <li>- Protected areas authorities</li> </ul> </li> <li>Local Regional services for:                             <ul style="list-style-type: none"> <li>- Spatial design</li> <li>- Water management</li> <li>- Forestry</li> <li>- Tourism</li> <li>- Energy</li> </ul> </li> </ul>	Incorporate ecological connectivity in TLI development into national policies and strategies during: <ul style="list-style-type: none"> <li>Development of regional strategies and master plans</li> <li>Planning of regional projects at a local level</li> <li>Development and management of data bases and provision information on biodiversity and spatial design</li> <li>Environmental impact assessment of SEAs and EIAs including cumulative impacts of multi-presence of existed or planning TLI</li> <li>Provision of permissions of SEAs and EIAs</li> <li>Implement the principles, special guidelines and standards of Sustainable TLI in practice</li> </ul>	X	X	TLI deliverables, products and tools which include ecological connectivity in their environmental sustainable approach, such as: <ul style="list-style-type: none"> <li>Regional strategies and master plans for TLI</li> <li>SEAs and EIAs including assessments on ecological connectivity</li> <li>Integrated plans and designs of concrete TLI projects in local level</li> </ul>
3	TLI national and private companies: <ul style="list-style-type: none"> <li>Highways constructors and operators</li> <li>Railways constructors and operators</li> <li>Energy production and transportation companies</li> </ul>	Implement during the planning process: <ul style="list-style-type: none"> <li>The knowledge and innovative solutions on “Infrastructure Ecology” and “Ecology Engineering”</li> <li>The national and regional policies, strategies, guidelines and standards</li> </ul>	X	X	
4	Private and public bodies and professionals: <ul style="list-style-type: none"> <li>Environmental and transport agencies</li> <li>Research centres</li> <li>Institutes</li> <li>Consultancy offices</li> <li>Studies’ Offices</li> <li>Researchers, biologists and Environmentalists</li> <li>Land owners</li> <li>Farmers, stockbreeders and agriculture corporations</li> <li>Tourism companies and corporations</li> <li>Hunters</li> </ul>	<ul style="list-style-type: none"> <li>Implement the principles, special guidelines and standards of Sustainable TLI in practice</li> <li>Preparation and production of SEAs and EIAs for Ministries and Regions’ strategies, plans and sectoral projects</li> <li>Preparation and production of the development of concrete TLI projects</li> <li>Develop effective methodologies, collection and use of Green Infrastructure background information and biodiversity data</li> <li>Implementation of the first phase of environment monitoring before the construction of a TLI</li> <li>Participation in open consultation and the development of a dialogue with the land users</li> </ul>	X	X	
5	<ul style="list-style-type: none"> <li>Civil society’s representatives of local communities, the general public and NGOs</li> </ul>	<ul style="list-style-type: none"> <li>Participation in open consultation and the development of a dialogue with the civil society and the public.</li> </ul>	X	X	

**C. IMPLEMENTATION AND MANAGEMENT LEVEL**

#	STAKEHOLDER	ACTION	Timeframe		EXPECTED OUTPUTS AND RESULTS
			2020-2025	2025-2030	
<b>Local</b>					
1	<ul style="list-style-type: none"> <li>• TLI public and private companies:</li> <li>• Highways constructors and operators</li> <li>• Railways constructors and operators</li> <li>• Energy production and transition companies</li> <li>• TLI industry's companies</li> </ul>	<ul style="list-style-type: none"> <li>• Construct, operate and maintain sustainable TLIs implementing in practice:</li> <li>• The knowledge and innovative solutions on "infrastructure ecology" and "ecology engineering"</li> <li>• The national and regional policies, strategies, guidelines and standards</li> </ul>	X	X	<ul style="list-style-type: none"> <li>• TLI projects are integrated with minimum impact on ecological connectivity and biodiversity</li> </ul>
2	<ul style="list-style-type: none"> <li>• Land owners and users of the adjacent and neighboring to TLI alignment areas:</li> <li>• Spatial planning services</li> <li>• Municipalities</li> <li>• Regions</li> <li>• Water management services</li> <li>• Forestry services</li> <li>• Owners of private forests</li> <li>• Farmers and Livestock owners</li> <li>• Hunters</li> <li>• Tourism areas owners and users</li> <li>• Other</li> </ul>	<ul style="list-style-type: none"> <li>• Contribute in practical implementation the sustainable use of land towards supporting the effective and functional ecological connectivity minimizing barriers for wildlife to approach and use the mitigation structures of TLI as wildlife crossings</li> </ul>	X	X	
3	<ul style="list-style-type: none"> <li>• Researches, institutes and organizations (public or NGOs)</li> <li>• Private and public bodies and professionals</li> </ul>	<ul style="list-style-type: none"> <li>• Implement monitoring projects for the environmental impacts of construction and operation of TLI</li> </ul>	X	X	
4	<ul style="list-style-type: none"> <li>• Representatives of Civil society, the public and NGOs</li> </ul>	<ul style="list-style-type: none"> <li>• Represent civil society and contribute towards effective environmental monitoring implementation</li> </ul>	X	X	
5	<ul style="list-style-type: none"> <li>• Supervising public authorities and services</li> </ul>	<ul style="list-style-type: none"> <li>• Supervise and provide permissions for the overall development of the construction, final operation and maintenance of the TLI based on the results of the monitoring projects</li> </ul>	X	X	

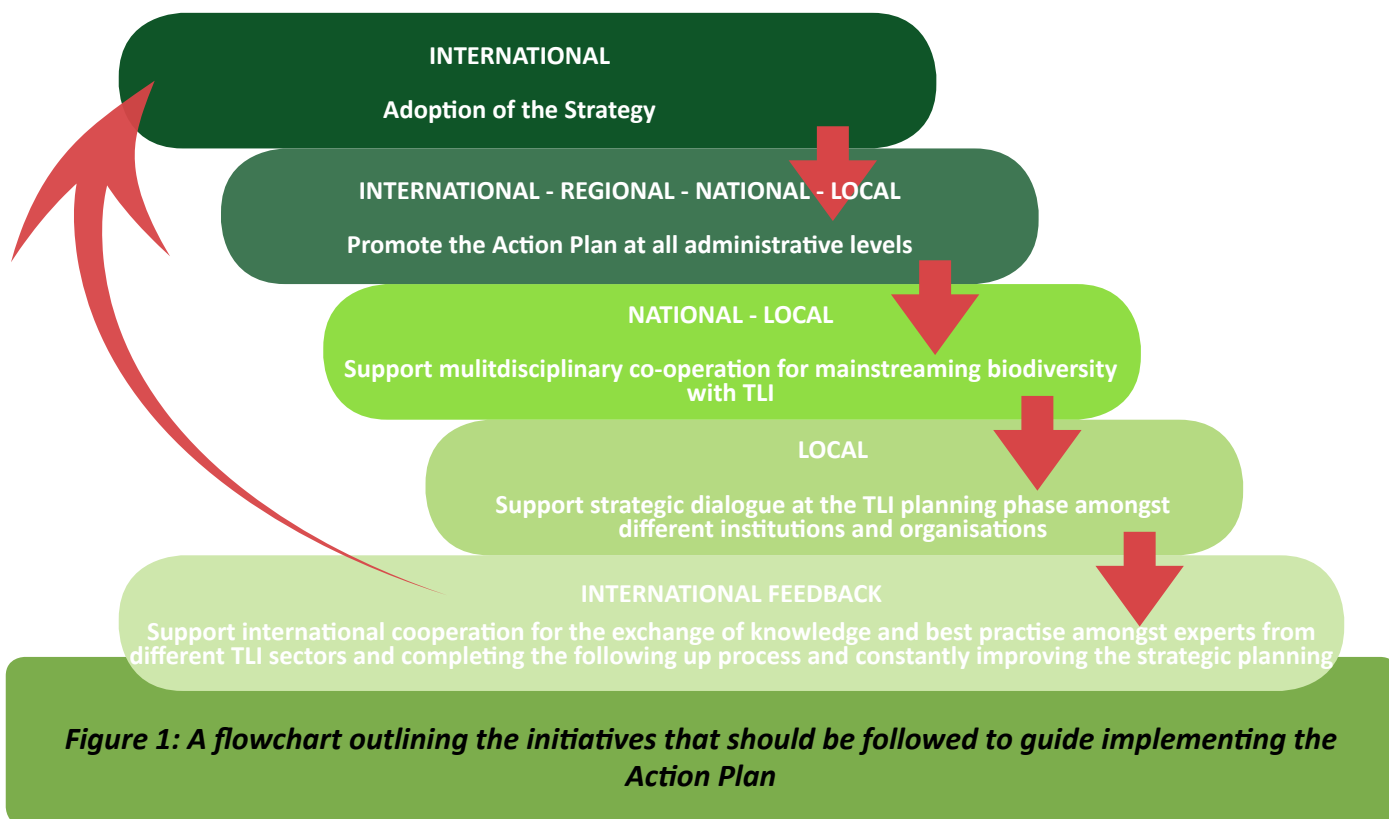


**D. LEVEL OF EDUCATION, AWARENESS, CONSULTATION AND COMMUNICATION**

#	STAKEHOLDER	ACTION	Timeframe		EXPECTED OUTPUTS AND RESULTS
			2020-2025	2025-2030	
<b>Local</b>					
1	<ul style="list-style-type: none"> <li>Universities and research institutions in synergies with TLI construction and operation companies</li> </ul>	<ul style="list-style-type: none"> <li>Increase and promote the scientific knowledge</li> <li>Improve the effective methodologies on measuring landscape and habitats' fragmentation</li> <li>Contribute to innovative and science based solutions in practice</li> <li>Implement the "culture of learning" principle</li> <li>Foster the new professionals for the future</li> </ul>	X	X	<ul style="list-style-type: none"> <li>TLI projects are integrated with minimum impact on ecological connectivity and biodiversity</li> </ul>
2	<ul style="list-style-type: none"> <li>Environmental agencies</li> <li>TLI agencies and administrations</li> <li>TLI public and private companies</li> <li>Institutes and Research centres</li> <li>Suppliers/business partners</li> </ul>	<ul style="list-style-type: none"> <li>Consult on developing policies and strategies in national and regional level</li> <li>Influence the sustainability of the final decisions</li> </ul>	X	X	
3	<ul style="list-style-type: none"> <li>Schools and Environmental Education Centres</li> </ul>	<ul style="list-style-type: none"> <li>Education of the future's citizens</li> <li>Implement the "culture of learning" principle</li> <li>Capacity-building of existing and future special target groups of the four administrative level of the Strategy</li> </ul>	X	X	
4	<ul style="list-style-type: none"> <li>Protected areas information and awareness centres</li> </ul>	<ul style="list-style-type: none"> <li>Support and increase the public awareness level</li> </ul>	X	X	
5	Civil society's representatives: <ul style="list-style-type: none"> <li>The public</li> <li>Local communities</li> <li>Drivers and Passengers</li> <li>Energy users</li> <li>NGOs</li> </ul>	<ul style="list-style-type: none"> <li>Support the overall bottom up process on decision making and public involvement</li> </ul>	X	X	
6	<ul style="list-style-type: none"> <li>Media</li> <li>Professionals on communication</li> <li>Opinion leaders</li> </ul>	<ul style="list-style-type: none"> <li>Promotion of public awareness and information</li> <li>Fostering political press and influence of the public on sustainable development</li> </ul>	X	X	

## 5.2. Implementation, follow up and funding of the Action Plan of the Global Strategy.

For the implementation of the Action Plan for TLI sustainable development, a framework of initiatives should be undertaken (*Figure 1*), from the higher, international level which filters down to a local level. It is imperative that experience and knowledge, gained at local levels, provide feedback of operations to the international levels. This will aid and support improving strategic planning as part of the follow up process.



Funding of the Action Plan can be achieved through:

1. Public and governmental funds that are already available for policy making (especially in response to critical present and future challenges of TLI connected ministries);
2. Public and/or private development funds (such as banks and/or private investors), connected with the planning, designing, construction, and operation of TLI and its relative investments. These funds should support the “responsible polluter pay principle” covering all costs (including the costs of the mitigation and compensation measures both during the construction and operation and maintenance of the TLI);
3. Public or private funds dedicated for research and innovation;
4. Public or private funds for cooperative development and networking (for example, to fund projects, conferences and workshops); and,
5. Public and private funds for education, capacity building and public awareness.

Finally, to complete a follow up process for the implementation of the Action Plan the creation of an **International Observatory** is proposed for **monitoring the fragmentation status globally** as an important threat for biodiversity loss. This Observatory can be coordinated by CBD and UN with support of our International Coalition on Transportation and Ecology and organisations from both the Transport and Environment Sectors.

## 6. BIBLIOGRAPHY

- AccountAbility, 2015. AA1000 Stakeholder Engagement Standard. p40. ([https://www.accountability.org/wp-content/uploads/2016/10/AA1000SES\\_2015.pdf](https://www.accountability.org/wp-content/uploads/2016/10/AA1000SES_2015.pdf))
- BSR, 2019. Five-Step Approach to Stakeholder Engagement. Business for Social Responsibility (BSR). p41. <https://www.bsr.org/en/our-insights/report-view/stakeholder-engagement-five-step-approach-toolkit>
- Brady S.P.- & Richardson J.L., 2017. Road ecology: shifting gears toward evolutionary perspectives, *Frontiers in Ecology and the Environment* (2017). DOI: 10.1002/fee.1458.
- Carpathian Convention, 2014. Protocol on Sustainable Transport to the Framework Convention on the Protection and Sustainable Development of the Carpathians. 26 September 2014, Mikulov, Czech Republic. <http://www.carpathianconvention.org>
- Carpathian Convention, 2003. Framework Convention on the Protection and Sustainable Development of the Carpathians. 22 May 2003, Kyiv, Ukraine. <http://www.carpathianconvention.org>
- Canters K.A., A.A.G. Piepers & D. Hendrick-Heersma, editors, 1997. Habitat fragmentation and infrastructure. Proceedings of the international conference on habitat fragmentation, infrastructure and the role of ecological engineering. 17-21 September 1995. Maastricht and The Hague, the Netherlands. Directorate General for Public Works and Water Management, Road and Hydraulic Engineering Division, Delft, the Netherlands.
- Cariani R., 2016. Concept for Stakeholders Engagement. Deliverable D.T1.1.2, ENAIP Veneto CERlecon project – CE119. p39.
- Chapron G., Epstein Y. & López-Bao J.V., 2019. A rights revolution for nature. Introduction of legal rights for nature could protect natural systems from destruction. *Science*, 29 MARCH 2019, Vol 363, ISSUE 6434, p1392- 1393.
- Convention on Biological Diversity, 2018. Mainstreaming of biodiversity in the energy and mining, infrastructure, manufacturing and processing sectors. Decision (14/3) adopted by the conference of the parties to the Convention on Biological Diversity. Fourteenth meeting Sharm El-Sheikh, Egypt, 17-29 November 2018 Agenda item 22.
- Secretariat of the Convention on Biological Diversity, 2017. Guidelines for an Integrated Approach in the Development and Implementation of National, Subnational and Local Biodiversity Strategies and Action Plans, 78 pages.
- Dulac J., 2013. Global land transport infrastructure requirements: estimating road and railway infrastructure capacity and cost to 2050. International Energy Agency, Paris.
- Durham E., Baker H., Smith M., Moore E. & Morgan V., 2014. The BiodivERsA Stakeholder Engagement Handbook. BiodivERsA, Paris. p108. (<http://www.biodiversa.org/stakeholderengagement>)
- European Commission, 2019. Review of progress on implementation of the EU green infrastructure strategy. Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. COM (2019) 236 final).
- Forman R.T.T., Sperling D., Bissonette J.A., Clevenger A.P., Cutshall C.D., Dale V.H., Fahrig L., France R., Goldman C.R., Heanue K., Jones J.A., Swanson F.J., Turrentine T. & Winter T.C., 2003. Road Ecology: Science and Solutions. Island Press, Washington, D.C.
- Georgiadis L., Ament R., Sjolund A., Hahn E., Boettcher M., van der Ree R., Newman K., Collinson W.- & Shilling F., 2019. The mainstreaming of biodiversity provisions in linear infrastructure by the transportation, energy, and mining sectors in Africa. Challenges and perspectives for an international strategy for engaging different stakeholders. Workshop in African Conference on Linear Infrastructure and Ecology: Building partnership and investing in nature. Book of abstracts. 10-15 March 2019. Skukuza Camp, Kruger National Park, South Africa. p82.
- Georgiadis L., Adelsköld T., Autret Y., Böttcher M., Hahn E., Rosell C., Sangwine T., Wagner P., Seiler A., Newman K., van der Ree R., Sjölund A. & Bekker H., 2018a. Towards developing sustainable Linear Transportation Infrastructure globally. Recommendations for priorities of international action. Final report of the IGELI project: International Guidelines for Ecologically-adapted Linear Infrastructure. IENE. Linköping, Sweden. P 40.
- GIB, 2017. SuRe® – the Standard for Sustainable and Resilient Infrastructure. Governance Bodies Terms of Reference. GO01. Global Infrastructure Basel Foundation. Basel Switzerland.P15. ([http://www.gib-foundation.org/content/uploads/2017/11/GO01\\_Governance-Bodies\\_ToRs.pdf](http://www.gib-foundation.org/content/uploads/2017/11/GO01_Governance-Bodies_ToRs.pdf)).
- Hambler C., 2004. Conservation. Studies in Biology. Cambridge University Press.
- Hilty J.\*, Worboys G.L., Keeley A.\*, Woodley S.\*, Lausche B., Locke H., Carr M., Pulsford I., Pittock J., White J.W., Theobald D.M., Levine J., Reuling M., Watson J.E.M., Ament R. & Tabor, G.M.\*, 2020. Guidelines for conserving connectivity through ecological networks and corridors. Best Practice Protected Area Guidelines Series No. 30. Gland, Switzerland: IUCN. \*Corresponding authors: Hilty (jodi@y2y.net), Keeley (annika.keeley@yahoo.com), Woodley (woodleysj@gmail.com), Tabor (gary@largelandscapes.org)
- Ibisch L.P., Hoffmann T. M., Kreft S., Pe'er G., Kati V., Biber-Freudenberger L., DellaSala A D., Vale M.M., Hobson R.P. & Selva N., 2016. A global map of roadless areas and their conservation status. *Science* 354(6318):1423-1427 · December 2016.
- IENE 2018. Declaration of IENE 2018 International Conference on Ecology and Transportation: Building bridges and crossing borders for the defragmentation of Europe. Eindhoven, the Netherlands, on September 11-14, 2018. (<http://www.iene.info/news/2018-connecting-europe-connecting-nature/>).
- IENE 2014. Declaration of IENE 2014 International Conference on Ecology and Transportation: Protect remaining roadless areas. Malmö, Sweden, September 16-19, 2014. (<http://www.iene.info/declarations/protect-remaining-roadless-areas/>).
- International Finance Corporation of the World Bank, 2017. Stakeholder Engagement: A Good Practice Handbook for Companies Doing Business in Emerging Markets. 201p.
- IPBES, 2019. Summary for policymakers of the global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. S. Díaz, J. Settele, E.S. Brondízio, H.T. Ngo, M. Guèze, J. Agard, A. Arneth, P. Balvanera, K.A. Brauman, S.H.M. Butchart, K.M.A. Chan, L.A. Garibaldi, K. Ichii, J. Liu, S. M.

- Subramanian, G.F. Midgley, P. Miloslavich, Z. Molnár, D. Obura, A. Pfaff, S. Polasky, A. Purvis, J. Razzaque, B. Reyers, R. Roy Chowdhury, Y.J. Shin, I.J. Visseren-Hamakers, K.J. Willis, and C.N. Zayas (eds.). IPBES secretariat, Bonn, Germany. 56 pages.
- Iuell B., Bekker G.J., Cuperus R., Dufek J., Fry G., Hicks C., Hlavac V., Keller V.B., Rosell C., Sangwine T., Torslov N.- & Wandall B. Le Marie, (Eds) 2003. *Wildlife and Traffic - A European Handbook for Identifying Conflicts and Designing Solutions*. Prepared by COST 341 - Habitat Fragmentation due to Transportation Infrastructure, Delft, The Netherlands, Ministry of Transport, Public Works and Water Management, Road and Hydraulic Engineering division, Delft, The Netherlands.
- Jeffery N., 2009. *Stakeholder Engagement: A Road Map to Meaningful Engagement*. Doughty Centre, Cranfield School of Management. p48. (<https://www.fundacionseres.org/lists/informes/attachments/1118/stakeholder%20engagement.pdf>)
- Jenkins A.R., Smallie J.J. & Diamond M., 2010. 'Avian collisions with power lines: a global review of causes and mitigation with a South African perspective'. *Bird Conservation International* 20(3):263-278. doi.org/10.1017/S0959270910000122
- Krick T., Forstater M., Philip M., Sillanpää M., Van der Lugt C., Partridge K., Jackson C. & Zohar A., 2005. *From Words to Action. The Stakeholder Engagement Manual. Volume 2: The practitioner's handbook on stakeholder engagement*. AccountAbility, the United Nations Environment Programme, and Stakeholder Research Associates. p150. (<http://www.unep.fr/shared/publications/pdf/WEBx0115xPA-SEhandbookEn.pdf>)
- Laurance W.F., 2018. *Conservation and the Global Infrastructure Tsunami: Disclose, Debate, Delay!* *Trends in Ecology and Evolution*. TREE 2401. p4.
- Laurance W.F., Campbell M.J., Alamgir M. & Mahmoud I. Mahmoud M.I., 2017. *Road Expansion and the Fate of Africa's Tropical Forests*. *Frontiers in Ecology and Evolution*. Vol 5, Article 75:1-7. doi: 10.3389/fevo.2017.00075.
- Leal Filho W. & Brandli L., (eds.), 2016. *Engaging Stakeholders in Education for Sustainable Development at University Level*, *World Sustainability Series*, DOI 10.1007/978-3-319-26734-0\_21. ([https://www.researchgate.net/publication/290429947\\_Engaging\\_Stakeholders\\_for\\_Sustainable\\_Development](https://www.researchgate.net/publication/290429947_Engaging_Stakeholders_for_Sustainable_Development))
- Loss S.R., Will T. & Marra P.P., 2014. 'Refining estimates of bird collision and electrocution mortality at power lines in the United States'. *PLoS One* 9(7), e101565. doi.org/10.1371/journal.pone.0101565
- MacNicol D., Giffin G. & Mansell P., (team authors), 2014. *Stakeholder engagement*. RICS Professional Guidance, UK. p29. ([https://www.apm.org.uk/sites/default/files/rics%20stakeholder%20engagement-final-proof-pw%20protected\\_0.pdf](https://www.apm.org.uk/sites/default/files/rics%20stakeholder%20engagement-final-proof-pw%20protected_0.pdf))
- Moț R., Georgiadis L., Ciubuc F., Grillmayer R., Kutal M., Gileva E., Voumvoulaki N., Hahn E., Sjölund A. & Stoian R., 2019. *State of Play Report on Harmonization of Green & Grey Infrastructure in Austria, Bulgaria, Czech Republic and Romania*. HARMON - Harmonization of Green and Grey Infrastructure in Danube Region; Danube Transnational Programme/ Seed Money Facility, 2019.
- Page-Nicholson S., Leeuwener L., Chetty K.- & Hoogstad C., 2019. Under Review. *Raptor electrocutions, collisions, and mitigating this threat: A summary of two decades*.
- Prinsen H.A.M., Boere G.C., Pires N. & Smallie J.J., 2011. *Review of the conflict between migratory birds and electricity power grids in the African-Eurasian region*. Bonn, Germany: CMS Technical Series n° 20, AEWA Technical Series n° 20.
- Secretariat of the Convention on Biological Diversity, 2020. *Global Biodiversity Outlook 5*. Montréal.
- Shaw J.M., 2013. *Power line collisions in the Karoo: Conserving Ludwig's Bustard*. PhD thesis, University of Cape Town.
- Shaw J.M., Pretorius M.D., Reid T., Gibbons B., Mohale O., Visagie R., Leeuwener L., Hoogstad C. & Ryan, P.G. 2017. *The effectiveness of line markers in reducing power line collisions of large terrestrial birds at De Aar, Northern Cape*. Eskom Research, Testing & Development. Report no. RES/RR/17/1939422.
- Sherwood B., Cutler D.- & Burton J., 2003. *Wildlife and Roads. The ecological impact*. Imperial College Press. London.
- Trocme et al, 2002. *Cost 341. Habitat Fragmentation due to Transportation Infrastructure*. The European Review. European Commission. Directorate General for Research.
- Van der Ree R., Daniel J. Smith J.D. & Gliro C., 2015. *Handbook of Road Ecology*. John Wiley & Sons, Ltd. West Sussex, UK.
- Van Rooyen C.S., 2004. *The Management of Wildlife Interactions with overhead lines. In The fundamentals and practice of Overhead Line Maintenance (132kV and above)*, pp217-245. Eskom Technology, Services International, Johannesburg.
- Ward M., Saura S., Williams B., Ramírez-Delgado J-P, Arafeh-Dalmau N., James R. Allan R.J., Venter O., Dubois G & Watson E. M. J., 2020. *Just ten percent of the global terrestrial protected area network is structurally connected via intact land*. *Nature Communications* (2020)11:4563. <https://doi.org/10.1038/s41467-020-18457-x>

**Website links:**

<https://www.theguardian.com/environment/2018/oct/09/brazils-bolsonaro-would-unleash-a-war-on-the-environment> [assessed on 04/09/2019]

<https://www.wwf.org.uk/updates/soy-highway-threatens-world-heritage-site> [assessed on 04/09/2019]

<https://news.mongabay.com/2019/08/new-road-risks-pandoras-box-of-disruption-in-worlds-most-biodiverse-national-park-commentary/> [assessed on 04/09/2019]

<http://english.boaoforum.org/en/index.html> [assessed on 04/09/2019]

<https://initiative20x20.org/about> [assessed on 04/09/2019]

<http://www.gms-eoc.org/uploads/resources/1192/attachment/27.Next-Steps.pdf> [assessed on 09/06/2017]

<https://www.cbd.int/ecosystem/> [assessed on 04/09/2019]

<https://www.mjpo.nl> [assessed on 10/09/2019]

## AUTHORS

### EUROPE

**Lazaros Georgiadis**, Environmental Consultant, Florina, Greece.

**Anders Sjölund**, Swedish Transport Administration, Borlänge, Sweden.

**Andreas Seiler**, Swedish University of Agricultural Sciences, Grimsö Wildlife Research Station, Sweden.

**Antonio Mira**, University of Evora, Portugal.

**Carme Rosell**, Minuartia, Barcelona, Catalonia, Spain.

**Cristian Remus (Cristi) Papp**, Wildlife and Landscape National Manager, WWF Danube Carpathian Programme Romania, Bucharest, Romania.

**Elke Hahn**, Federal Ministry of Climate Action, Environment, Energy, Mobility, Innovation and Technology, Vienna, Austria.

**Fiona Mathews**, Mammal Society, University of Sussex, Falmer, UK.

**Hans Bekker**, Department Public Works; Dutch Ministry for Transport and Water Management, Retired, Netherlands.

**Hildegard Meyer**, WWF Central and Eastern Europe, Vienna, Austria.

**Jose Rafael Garrido López**, Environmental and Water Agency, Regional Government of Andalucía, Spain.

**Marguerite Trocmé**, Federal Roads Office (FEDRO), Federal Department of the Environment, Transport, Energy and Communications (DETEC) Switzerland.

**Marita Böttcher**, Federal Agency for Nature Conservation (BfN), Leipzig, Germany.

**Radu Mot**, Association Zarand, Brasov, Romania.

**Sandro Bertolino**, Department of Life Sciences and Systems Biology, University of Turin

Torino, Italy.

**Tony Sangwine**, Highways England, Bristol, UK.

**Vaclav Hlavac**, Nature Conservation Agency, Prague, Czech Republic.

**Yannick Autret**, Ministry for an Ecological Transition, Paris, France.

### AFRICA

**Kishaylin Chetty**, Biodiversity Centre of Excellence, Environmental Management, Sustainability Division, Eskom, Johannesburg, South Africa.

**Lourens Leeuwner**, Wildlife and Energy Programme, The Endangered Wildlife Trust, Johannesburg, South Africa.

**Sarah Chiles**, Ewaso Lions and Grevy's Zebra Trust, Kenya.

**Wendy Collinson**, Wildlife and Transport Programme, The Endangered Wildlife Trust, Johannesburg, South Africa.

### ASIA

**Xiaochun Qin**, Associate Professor, Department of Road and Railway Engineering, Faculty of Civil Engineering, Beijing Jiaotong University, Beijing, China.

**Yun Wang**, Research Center for Environment Protection and Water and Soil Conservation, China Academy of Transportation Sciences, Beijing, China.

### AUSTRALIA

**Rodney Van der Ree**, Ecology and Infrastructure International Pty Ltd, Melbourne, Australia.

### NORTH AMERICA

**Fraser Shilling**, Road Ecology Centre, University of California, Davis, USA.

**Kate Newman**, WWF-USA, Washington, US.

**Rob Ament**, Center for Large Landscape Conservation, (IUCN/CCSG/TWG), Montana, US.

### SOUTH AMERICA

**Juliana Moreno Pina**, Licensing Department at the São Paulo State Environmental Agency – CETESB, São Paulo, Brasil.

# A Global Strategy for Ecologically Sustainable Transport and other Linear Infrastructure

Supported by

