APRSO and CAREC webinar series on **Innovations in Safe and Sustainable Transport: Road Safety as part of Liveable & Resilient Cities.**

# Aligning Green Roads and Road Safety

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# What are Green Roads and why are they needed?

**Definition:** “Green roads will foster beneficial land and water use, reduce pollution, support restorative and regenerative ecosystems and enhance safe and affordable mobility of people to deliver inclusive low-carbon, resilient development and environmentally considerate outcomes.”

**Enormous footprint of roads in many green sectors**

**Big challenge to make all roads safe**

**We need to move from regular roads to green and safe roads**

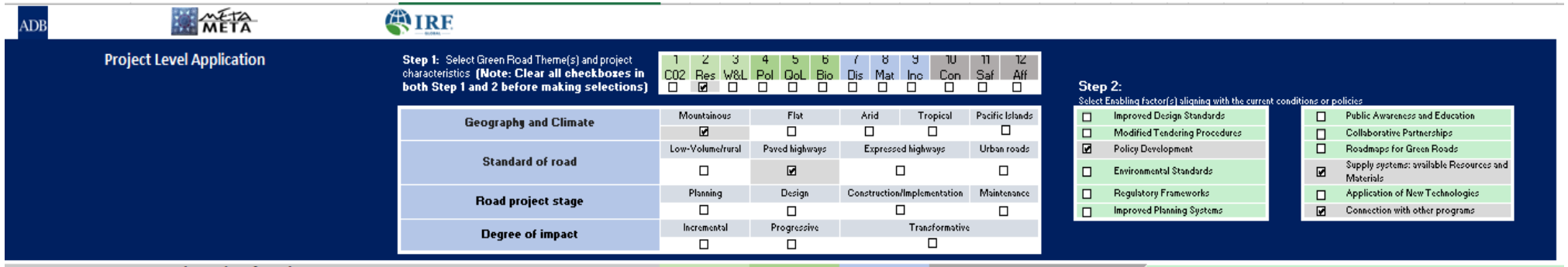
# Green Roads and Road Safety: Strong Synergies!!

| Green Roads Theme | Importance |
|---|---|
| Decarbonization | Use introduction of EV technologies to upgrade safety standards |
| Climate resilience | Resilience and road safety mutually reinforcing |
| Water management | Avoid disruption, avoid aquaplaning |
| Pollution control | Enhance visibility (road side vegetation) |
| Quality of life | Avoid road casualties (equivalent to 3-5% of GDP)<br>Enhance driver alertness (road side vegetation) |
| Biodiversity | Avoid animal collisions |
| Disaster risk reduction | Road safety during calamities (evacuation routes) |
| Safe sourcing | Anti-skidding material |
| Includive growth | Avoid economic loss due to casualties in economically most active group; traffic seperation for vulnerable road users, protect road workers |

# What help can we get from Green Roads Toolkit?

- **A Collection of Best Practices**: Includes 150 different Green Roads practices that can be applied to road management, planning, design, construction, and asset management
- **Easy to Search**: Organized into nine green themes and can be filtered by different categories.
- **Includes additional helpful tools**: Comes with checklists and other tools, including maturity assessment of enabling framework
- **Customizable Use**: Designed to support the creation of tailored road programs that promote sustainability

# Green Roads Toolkit: Generating overview of relevant best practices



Project Level Application

**Step 1:** Select Green Road Theme(s) and project characteristics **(Note: Clear all checkboxes in both Step 1 and 2 before making selections)**

| 1 CO2 | 2 Res | 3 W&L | 4 Pol | 5 QoL | 6 Bio | 7 Dis | 8 Mat | 9 Inc | 10 Con | 11 Saf | 12 Aff |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ☐ | ☑ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

| | | | | | |
|---|---|---|---|---|---|
| **Geography and Climate** | Mountainous ☑ | Flat ☐ | Arid ☐ | Tropical ☐ | Pacific Islands ☐ |
| **Standard of road** | Low-Volume/rural ☐ | Paved highways ☑ | Expressed highways ☐ | Urban roads ☐ | |
| **Road project stage** | Planning ☐ | Design ☐ | Construction/Implementation ☐ | Maintenance ☐ | |
| **Degree of impact** | Incremental ☐ | Progressive ☐ | Transformative ☐ | | |

**Step 2:**
Select Enabling factor(s) aligning with the current conditions or policies

| | |
|---|---|
| ☐ Improved Design Standards | ☐ Public Awareness and Education |
| ☐ Modified Tendering Procedures | ☐ Collaborative Partnerships |
| ☑ Policy Development | ☐ Roadmaps for Green Roads |
| ☐ Environmental Standards | ☑ Supply systems: available Resources and Materials |
| ☐ Regulatory Frameworks | ☐ Application of New Technologies |
| ☐ Improved Planning Systems | ☑ Connection with other programs |

**Green Road Practices found** 48

GR objectives served: ● Core contributions ○ Secondary contributions

| Green Road Theme | Intervention Area | No. | Pracitce Name | 1 CO2 | 2 Res | 3 W&L | 4 Pol | 5 QoL | 6 Bio | 7 Dis | 8 Mat | 9 Inc | 10 Con | 11 Saf | 12 Aff |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Decarbonization | 1.4. Vegetative measures to sequester CO2 | 1.4.1 | Roadside tree planting for sequestering CO2 | ● | ○ | ○ | ○ | ○ | ○ | | | ○ | | ○ | |
| 2. Climate Resilience | 2.1. Resilient routing/ avoiding vulnerable areas | 2.1.1 | Moving roads out of channel migration zones | | ● | ○ | | | | | | | | | |
| 2. Climate Resilience | 2.1. Resilient routing/ avoiding vulnerable areas | 2.1.2 | Avoid unstable and wet areas | | ● | ○ | | | | ○ | | | | | |
| 2. Climate Resilience | 2.2. Climate resilient road drainage design | 2.2.1 | Preventing stream diversion at road-stream crossings | | ● | | ○ | | | ○ | | | | ○ | |
| 2. Climate Resilience | 2.2. Climate resilient road drainage design | 2.2.2 | Avoid using multiple small culverts | | ● | | | | | | | | | | |
| 2. Climate Resilience | 2.2. Climate resilient road drainage design | 2.2.3 | Climate resilient culvert design | | ● | ○ | | | | ○ | | | | | |
| 2. Climate Resilience | 2.2. Climate resilient road drainage design | 2.2.4 | Road surface drainage to prevent water concentration | | ● | | ○ | | | ○ | ○ | | | | |
| 2. Climate Resilience | 2.3. Increased Stabilization of road sides | 2.3.1 | Complete ground cover in disturbed areas | | ● | ○ | | | | | | | | | |

Enabling factors: Improved Design Standards; Modified Tendering Procedures; Policy Development; Environmental Standards; Regulatory Frameworks; Improved Planning Systems; Public Awareness and Education; Collaborative Partnerships; Roadmaps for Green Roads; Supply systems: available Resources and Materials; Application of New Technologies; Connection with other programs

GREEN ROADS TOOLKIT

Download the Green Roads Toolkit

SCAN ME

# Zoom into roadside vegetation and traffic safety

**Roadside vegetation – both in rural and urban areas – is closely connected to road safety, besides many of other functions (productive use, carbon sequestration, dust and noise control, reduce pollution, support biodiversity)**

**Key safety functions of roadside vegetation:**

- Separation of traffic lanes
- Visibility
- Driver alertness
- Avoid collision risk – rules on roadside fixed objects/ trees

# (1) Separation of traffic lanes

- **Landscaped buffers (green strips) between sidewalks and roads:**
  - Reduce the risk of vehicles entering pedestrian zones
  - Help lower vehicle speeds
  - Separate non-motorized users from other traffic

- **Dedicated bike lanes and multi-use paths create safer spaces for cyclists and pedestrians.**

- **Result: Safer, more comfortable environments for everyone on the road.**

# (2) Visibility and reduced glare

**Guide road alignment** by providing visual cues that help drivers anticipate curves and changes in the road

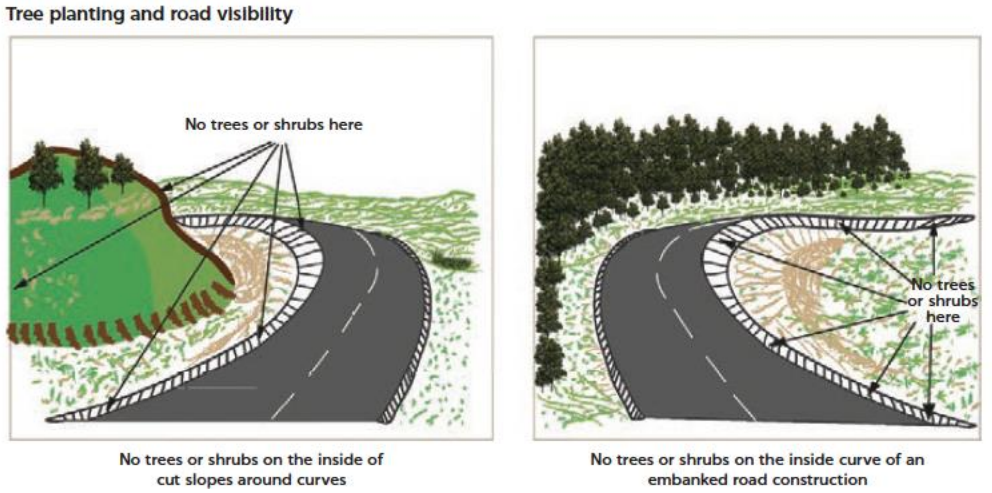
**Avoid blocking sightlines:** Grass or bushes on both sides of sharp road bends increase the visibility of the road prism

**Reduce glare and squinting:**

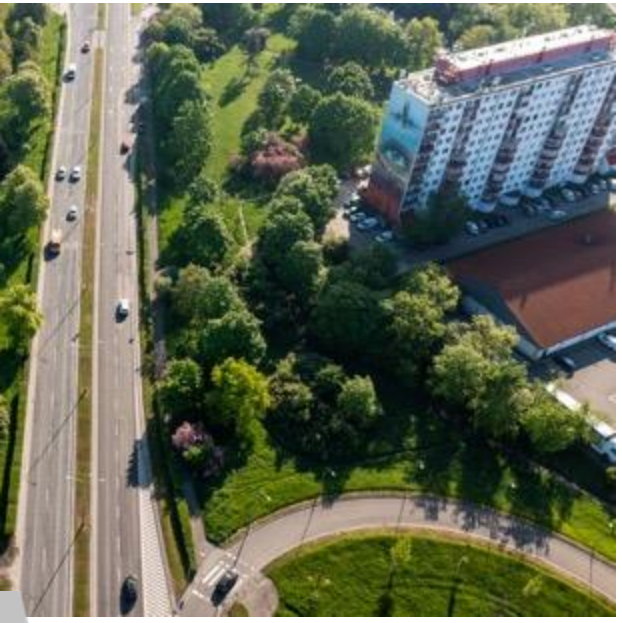
Dense belts of tall trees provide dimmed lighting particularly in direction low sun

Bush strips on median dividers to reduce the risk of being blinded by oncoming vehicle headlights

**Signal caution** in areas like residential zones or entrance to urban zones using landscaping to visually narrow the road and calm traffic .



# (3) Driver alertness



**Break visual monotony**

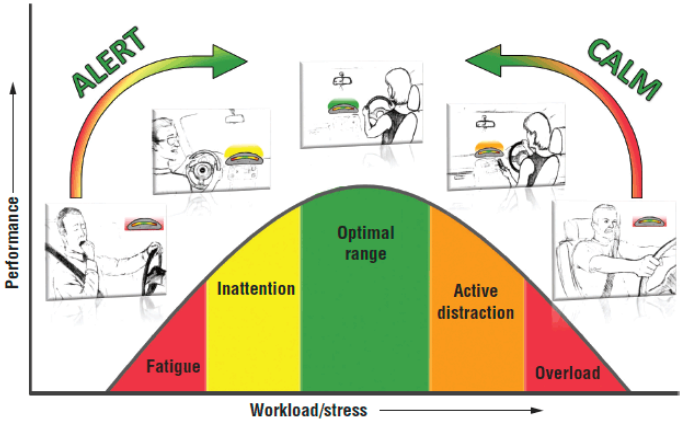
- Long, monotonous drives (especially on highways or rural roads) can lead to driver fatigue and micro-sleep episodes
- Trees and varied vegetation break visual monotony, keeping drivers alert

**Attention restoration theory**

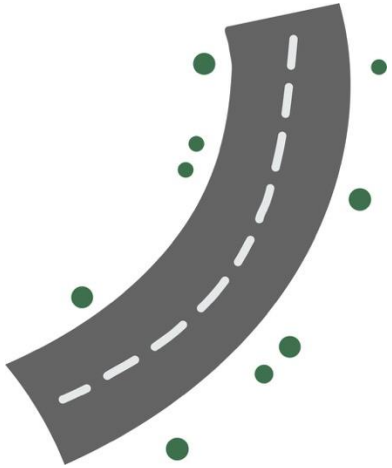
- Exposure to natural elements like trees and greenery is linked to
  - Lower stress levels
  - Improved cognitive function
- Moderate greenness and complexity (mix of shrubs and trees) are optimal for driving performance[4]

**Perception of public space**

- Roads and their surroundings shape how we perceive public space – affects better discipline



# (3) Driver alertness – manage ‘optical flow’



## Trees as visual cues

- Rows of trees create a sense of motion and speed through optical flow.
- As roadside objects pass by faster or **irregularly**, drivers subconsciously adjust their speed and stay more alert.

## Behavioral impact

- Without vegetation, the sense of enclosure disappears, leading to increased speeds [1]
- When trees are placed closer to the road edge, drivers tend to:
  - Slow down
  - Shift toward the centerline [3]

## Optimal Design

- Tree spacing of 5–10 m is ideal for maintaining driver alertness on long roads [2] – but variation avoids drowsiness
- Vegetation acts as a natural speed-reducing visual measure, especially effective in rural and arterial roads.

# (4) Avoid collision

## Roadside vegetation planning

- Depends on traffic speed.- the lower the speed the less restrictions
- Use barriers in high-speed zones
- Consider bushes and undergrowth rather than trees
- In general, in roadside vegetation dombine different functions

TABLE 12.1 Roadside vegetation and road safety measures

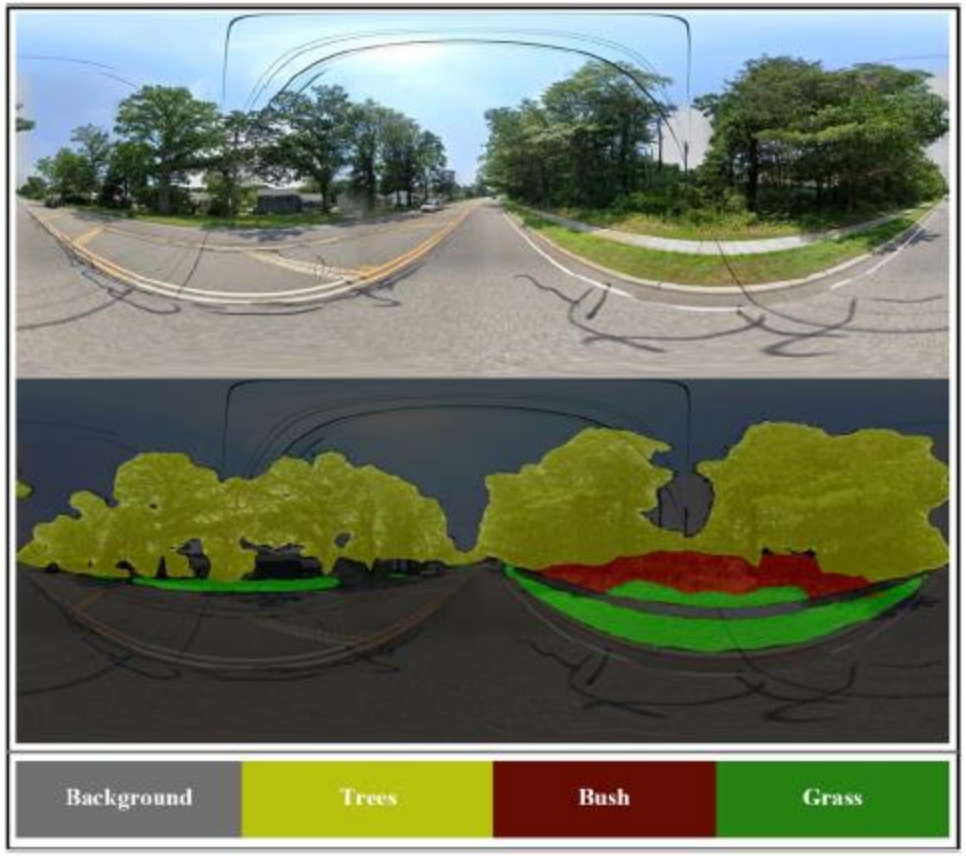
| SPEED ZONE | ROAD SAFETY MITIGATION METHOD | |
|---|---|---|
| 40 km/h | The impact force is unlikely to exceed human tolerances, so no specific mitigation is needed. However, it would be beneficial to have a minimum lateral offset of 1 m between edge of lone/curb face to mature front face of tree. | |
| 50 km/h | A minimum lateral distance from the road edge of 1.5 m of lateral offset between edge of lone/curb face to mature front face of tree should be maintained to reduce incidental interaction between vehicles and trees. | |
| 60 km/h | **Intersections** | at least 10 m beyond intersection on the approach and departure side |
| | **Driveways** | at least 3 m between edge of lone/curb face to mature front face of tree |
| | **Lane merge locations** | 3.6 m between edge of lane/curb face to mature front face of tree |
| | **Curves** | 3.6 m between edge of lane/curb face to mature front face of tree for gentle curves; barrier for moderate/tight curves |
| 70-100 km/h | The impact force is highly likely to exceed human tolerances and trees are not beneficial in these scenarios.<br>Safety barriers are the most appropriate mitigation (wire rape safety barrier, guard rail or other approved safety barrier that is suitable in high-speed environments) | |

*Source:* MetaMeta, (www.roadsforwater.org).

*In a German case, a landscaped center strip with narrower traffic lanes was found to be effective in calming traffic and increasing traffic safety. After being built, overall accidents were reduced by 30%, the number of accidents with injuries was cut by about 60%, and accidents involving street-crossing*

# Tools for road and urban planning using the Green View Index (GVI)

- The Green View Index (GVI) is a powerful tool in road and urban planning to quantify and improve the visual presence of greenery in streetscapes.
- The GVI measures the percentage of visible greenery (trees, grass, plants) from a pedestrian or driver's eye-level perspective using street-level images (Street View, etc)
- GVI supports road planning by:
  1. Identifying areas for greening
  2. Guiding street design standards,
  3. Evaluating the impact of design choices
  4. Supporting multi-model transport goals
  5. Enhancing equity in streetscapes
  6. Providing public health and thermal comfort planning



# What Next: Reflecting on Green Roads Toolkit Phase 2

- **Integrate road safety linkages throughout all practices**
- **Include road safety as extra category in Green Roads Toolkit**

# THANK YOU!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