EXECUTIVE SUMMARY

SUSTAINABLE TRANSPORT RESEARCH AND TRAINING IN ASIA AND THE PACIFIC.

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This document is issued without formal editing.

The full report will be published after the Conference
I. Introduction

1. As part of the project entitled “Enhancing cooperation among transport research, education and training institutes and government agencies for sustainable transport development in selected countries of Asia and the Pacific”, the ESCAP secretariat commissioned a study by an international consultant that would review existing training practices for transport professionals, assess research, training and education gaps and needs for Asia-Pacific region and develop recommendations on formulating a comprehensive sustainable transport development training programme incorporating three dimensions of sustainable development (economic, social and environment). The present document is an extended executive summary of the finding that will be presented at the Regional Conference on Transport Research and Education on 22-23 September 2021. The full report will be published after the conference.

II. Key findings

2. Over the past 50 years, the Asia-Pacific region has made impressive progress in reducing poverty and accelerating economic growth. However, the region still faces unresolved development issues such as poverty and vulnerability, increasing inequality, the impact of climate change, growing environmental pressures and huge infrastructure deficits.

3. Infrastructure plays a key role in achieving sustainable development and has a direct and indirect impact on more than 80% of the UN SDG targets. Through the creation and use of sustainable infrastructure, it is possible to achieve the necessary economic, social and environmental results within the framework of the sustainable development goals:

   • Goal 3 (Target 3.6 - Halve the number of global deaths and injuries from road traffic accidents),
   • Goal 7 (target 7.3 – Double the global rate of improvement in energy efficiency),
   • Goal 9 (target 9.1 - Develop of quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all, target 9.4 - by 2030, upgrade infrastructure and retrofit industries to make them sustainable with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capacities)
   • Goal 11 (11.2 provide access to safe, affordable, accessible and sustainable transport systems for all by improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons)

4. Along with the positive factors influencing the attainment of the SDGs, the transport system of the Asia-Pacific region has a direct impact on the state of the environment:
Transport is a powerful generator of greenhouse gas emissions and negatively affects biodiversity, destroying natural ecosystems. Transport is a source of threats of man-made disasters and is sensitive to extreme natural disasters.

5. Transport remains the largest consumer of electricity, the use of these resources grew on average 2% per year in the period 2000-2018, growth slowed by 0.8% in 2019, and in 2021 global energy consumption fell in 2020 (-4%) due to isolation measures and transport restrictions in contrast to the previous figures (Figure 1).

6. In the Asia-Pacific region, the transport sector accounts for 19% (852 million tons of oil equivalent) of total final energy consumption and 52% of total oil consumption.

7. China remains the largest energy consumer (24% of global energy consumption in 2020) and has recovered quickly from the COVID-19 crisis. China's energy consumption grew by 2.2%, much slower than in previous years (+ 4% over the 2008-2018 period and + 3.4% in 2019). Access restrictions and declining economic activity have had a major impact on energy consumption in 2020. It dropped significantly (-7.6%) in the US, by about 7% in the EU and Japan, and in Russia - by 4.8%. The decline was more modest (about -3%) in India and even less (about -2%) in Australia.

**Figure 1 - Trend of energy consumption in the world over the period from 1990 to 2020**
8. The transport sector accounts for 36 percent of the world’s total energy use, with road transport alone accounting for about 60 percent of that. If left unchecked and added to the growing level of motorization in developing countries, the environmental burden of the transport sector could increase substantially, leading to an increase in energy consumption of up to 82 percent and CO2 emissions by 79 percent by 2050.

9. The issue of energy efficiency of various modes of transport should be considered from the point of their influence on the climatic situation in the region and the volume of environmental pollution, as well as the efficiency of fuel costs per unit of work performed.

10. As well as transporting 40 times more passengers per square meter of vehicle and consuming only a third of the fuel to transport 1 tonne-km, rail transport is also a more environmentally friendly transport in terms of environmental emissions compared to road transport.

11. Figure 2 shows the degree of negative impact on the environment by various modes of transport. Railways can reduce negative impacts by up to 87 percent compared to roads per thousand tonne-km and over 81 percent per passenger-km, especially with regard to air pollution and climate change.

**Figure 2 – Negative impact on the environment**

12. The progress report on the 2019 Regional Roadmap for the 2030 Agenda for Sustainable Development in Asia and the Pacific shows that transport development has been focused on roads and has not optimized the comparative advantages of each mode of transport in terms of the three dimensions of sustainable development.
13. Significant problems of a social nature are associated with gender inequality, which is significant in the Asia-Pacific countries, where women are employed in less than 20 percent of jobs in the transport sector and are extremely underrepresented in leadership positions in transport, logistics and infrastructure. Therefore, gender aspects are less likely to be taken into account in decision-making;

14. Almost 60% of women in the region work in the informal economy, which puts them at greater risk of impoverishment especially in the pandemic conditions.

15. Meanwhile, the transport sector worldwide is dominated by men, and indeed, the proportion of women has decreased over the decade 2008-2018 from 20 to 18 percent, according to the ILO. This share for countries in Africa and Asia is significantly lower at 8.1 and 8.4% (compared to 23.2% in North America). A more detailed regional analysis shows that in developed countries, the average percentage of women employed in transport is higher than in developing countries. Women make up 32 percent of transport, storage and communications workers in Singapore, 21 percent in Japan, and 19 percent in Malaysia, they represent only one percent of the transport workers in Pakistan, where female labor force participation was 13 percent. In the Philippines, women accounted for 10 per cent of transport workers dispatchers and technicians on ships and aircraft;

16. Research shows a correlation between variety of groups of employees and improved business performance, for example, firms in Asia that have gender diversity in their executive teams are 21% more likely to report above average profitability. In addition, companies that prioritize supplier diversity (for example, increasing the number of women-owned businesses in the supply chain) have a 133 percent higher return on investment in procurement

17. The study of the main directions of development of transport systems, taking into account digital transformations, showed that information and communication innovative technologies and intelligent transport systems (ITS) will become a catalyst for sustainable development and overcoming problem areas in the future (Table 1).
## Table 1. Transport and ITS role in achieving SDGs

<table>
<thead>
<tr>
<th>Goal 3: Ensure healthy lives and promote well-being for all at all ages</th>
<th>Target indicators</th>
<th>3.6 By 2020, halve the number of global deaths and injuries from road traffic accidents 3.9 By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing ITS solutions</td>
<td>• Vehicle Collision Avoidance uses radar, and in some cases laser and video sensors, to detect an immediate risk of collision.  • Driving assistance systems, based on smart sensor technology, continuously monitor the environment around the vehicle and the driver's behavior. They detect potentially dangerous situations at an early stage and actively support the driver.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Goal 7: Ensure access to affordable, reliable, sustainable and modern energy for all</th>
<th>Target indicators</th>
<th>7.1 - By 2030, ensure universal access to affordable, reliable and modern energy services. 7.2 - By 2030, increase substantially the share of renewable energy in the global energy mix 7.3 - By 2030, double the global rate of improvement in energy efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing ITS solutions</td>
<td>Providing a reliable source of electricity for vehicles through smart grid applications and / or through the use of new technological solutions:  • buses with high-speed charging at “flash stations”, such as buses participating in the TOSA pilot project of the Geneva Public Transport Authority;  • the induction charging method, as used, for example, in the Utah State University prototype bus with a wireless induction charging system;  • technology based on the effect of “resonance in a directional magnetic field”, which was applied in Gumi (South Korea) and consists in the fact that electric cables laid in asphalt create an electromagnetic field for public transport buses (but not cars); This electromagnetic field is then converted into electricity by the induction coil of the bus battery, which can be located more than half a foot from the roadway.</td>
<td></td>
</tr>
</tbody>
</table>

| Goal 9: Build resilient infrastructure, promote inclusive and sustainable | Target indicators | 9.1 - Develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all |
## Industrialization and foster innovation

**Existing ITS solutions**

Convoy traffic organizations are groups of vehicles that move together and actively exchange information with each other and with the road infrastructure. Low aerodynamic drag is maintained for vehicles in a dense convoy, which can significantly reduce fuel consumption and emissions of air pollutants. The reduction in drag leads to a 20-25% reduction in fuel consumption and emissions. European project SARTRE; California's PATH Road Automation Program, the GCDC Collaborative Driving Automation Initiative; SCANIA convoy traffic organization project; as well as the Japanese project for the organization of the movement of convoys of trucks "Energy ITS".

### Goal 11: Make cities and human settlements inclusive, safe, resilient and sustainable

**Target indicators**

11.2 - By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons.

**Existing ITS solutions**

Intersection control systems to optimize traffic flows and reduce emissions;
- cameras for video recording of speeding and red light traffic lights;
- “smart” traffic lights, which can increase the time allotted for pedestrians to cross the road, when required;
- signs with variable messages that provide up-to-date information about the situation on the road, the availability of free parking spaces or the operation of public transport in real time;
- services for providing the necessary information before starting or during a trip by city public transport (using WAP, SMS, etc.);
- services for the sale of combined tickets for trips, which involve various types of transport, e-tickets, etc.

### Goal 12: Ensure sustainable consumption and production patterns

**Target indicators**

12.2 - By 2030, achieve the sustainable management and efficient use of natural resources.

**Existing ITS solutions**

Eco-Adaptive Balancing and Control System (EcoABC): This system is designed to distribute traffic flows in an energy efficient manner within the road system at a centralized level.
<table>
<thead>
<tr>
<th>Goal 13: <strong>Take urgent action to combat climate change and its impacts</strong></th>
<th>Target indicators</th>
<th>13.1 - Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries. 13.2 - Integrate climate change measures into national policies, strategies and planning</th>
</tr>
</thead>
</table>
| **Existing ITS solutions** | ITS applications that have proven to be effective in reducing CO2 emissions include the following: | • Advanced traffic management system  
• Advanced navigation system  
• Dynamic route selection system  
• ACCS (Adaptive Cruise Control System)  
• ETC (Electronic Toll Collection System)  
• Improved logistics system  
• Dynamic Parking Space Finder: An SPS pilot program that was conducted in San Francisco from 2009 to 2013 showed the potential to reduce emissions by 30%. |
18. The analysis of the issues pertaining to the harmonization of regional and intergovernmental agreements in the economic and social spheres and in connection with SDGs, revealed the typical difficulties of interaction in this area:

- Different levels of economic development of the Asia-Pacific countries and their transport systems, a variety of prevailing modes of transport
- The non-binding nature of relations between regional transport systems
- Some organizations which were set up for the purpose of economic integration in a specific area or to achieve specific goals prefer to carry out their work on the basis of informal interaction (processes).
- Significant religious and cultural differences, ethnic and regional differences
- COVID-19 pandemic

19. To mitigate these problems, the ESCAP Transport Division, with funding support by the Russian Federation, in implementing a project entitled “Strengthening cooperation between transport research, education and training institutions and government agencies for sustainable transport development in some countries of the Asia-Pacific region”, funded by the Russian Federation. As part of the implementation of this project, a concept for a transport scientific and educational network was designed with the aim to facilitate regional cooperation and exchange of knowledge between transport research institutes of the ESCAP member states. The network is envisaged to utilize all existing online and offline tools to address key means of achieving sustainable development in the following thematic areas:

- Transport connectivity and regional integration;
- Environmentally sustainable transport systems and services;
- Measures to mitigate the effects climate change
- Safe and inclusive transport and mobility.

20. For transport policy-makers to be relevant and effective, they should have access to analytical research and scientific insights on relevant issues and be appropriately trained to develop new, updated and specialized skills to understand broader social, economic and environmental impacts and to be capable of the use of appropriate new technologies in the implementation of sustainable transport policies and programs and the development of sustainable transport systems.

21. The conducted research examined curricula of 228 educational programs of 24 universities in the Asia-Pacific region and carried out their expertise from the point of reflecting the Sustainable Development Goals. The results showed a singular presence of special educational programs in the field of sustainable development for retraining and advanced training in European universities and universities in the Asia-Pacific region. Courses include both system-scale issues - on the environmental responsibility of business, on sustainable development goals as a global transdisciplinary vision of the future, addressing sustainability and development beyond the Sustainable Development Goals, and special topics such as
the use of electric vehicles and mobility, operational problems when using sustainable fuels, global health at the intersection of humans, animals and ecosystems, etc.

22. Only 3 educational programs of universities are devoted to sustainable transport, less than 10% of undergraduate and graduate educational programs provide for several aspects of sustainable development, about 60% of educational programs mention the SDGs, and open-access data has shown that more than 30% of educational programs do not explicitly mention the SDGs (Table .2).

**Table 2 - Overview of SDG representation in higher education of APR countries**

<table>
<thead>
<tr>
<th>Country</th>
<th>Number of curricula</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SDG-focused</td>
</tr>
<tr>
<td>Korea</td>
<td>-</td>
</tr>
<tr>
<td>China</td>
<td>-</td>
</tr>
<tr>
<td>Japan</td>
<td>1</td>
</tr>
<tr>
<td>Australia</td>
<td>2</td>
</tr>
</tbody>
</table>

23. An effective tool to create a cluster of public administration and business employees in the transport sector and university professors should be a new training module, integrated into the national training modules of the APR countries, taking into account the priority of the goals that are being addressed at the present stage by the ESCAP countries.

24. Training according to the program is aimed at building up the potential of organizations in the public and private sectors of the transport systems of the APR by organizing training in forms of retraining and refreshment training programs. When implementing the educational module, on-line and off-line technologies can be applied.

25. The program is targeted and variable in nature, the volume of the program depends on the needs of students, their organizations and the level of competence development. There are four options for the scope of the program:

- For top managers of transport organizations and government agencies
- For mid-level managers who practically develop measures for the development of transport in accordance with the UN Agenda
- Operational managers of transport organizations and university professors
- Basic educational programs for university students (master’s level).

26. In the study process all sections and topics include the educational content of the section in relation to the Asia-Pacific region as a whole, and also take into account national characteristics, interests and the level of development of the transport sector of the country in which the training is conducted.
II. Depending on the goals and involvement of states in the implementation of the SDGs, it is possible to embed educational modules of these types into university educational programs of bachelors and specialists.

III. Proposed training program for specialists in the field of transport: "Sustainable Development Goals in transport development programs"

Table 3 - Curriculum and thematic plan of the educational program for specialists in the field of transport: "Sustainable Development Goals in transport development programs"

<table>
<thead>
<tr>
<th>№</th>
<th>Study topics</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Socio-economic and environmental aspects of transport (Asian Highway networks, Trans-Asian Railway networks and dry port networks)</td>
<td>20 26 40 204</td>
</tr>
<tr>
<td>1.1</td>
<td>Road transport on the Asian Highway network</td>
<td>6 8 12 72</td>
</tr>
<tr>
<td>1.2</td>
<td>Rail transport on the Trans-Asian Railway network</td>
<td>6 8 12 72</td>
</tr>
<tr>
<td>1.3</td>
<td>Dry ports and intermodal facilities in the Asia-Pacific region</td>
<td>4 6 10 36</td>
</tr>
<tr>
<td>1.4</td>
<td>Sustainable transport systems</td>
<td>4 4 6 24</td>
</tr>
<tr>
<td>2</td>
<td>Use of alternative fuels and new powertrain technologies (road and rail)</td>
<td>20 28 64 204</td>
</tr>
<tr>
<td>2.1</td>
<td>Current state and development paths of alternative fuels and new powertrain technologies for road and rail transport in the Asia-Pacific region</td>
<td>8 8 22 72</td>
</tr>
<tr>
<td>2.2</td>
<td>Environmental aspects of using alternative energy sources</td>
<td>6 8 20 72</td>
</tr>
<tr>
<td>2.3</td>
<td>Alternative fuels in road and rail transport</td>
<td>6 12 22 60</td>
</tr>
<tr>
<td>3</td>
<td>Energy efficiency of transport (road and rail) (under SDG 7 Affordable and Clean Energy)</td>
<td>18 28 64 108</td>
</tr>
<tr>
<td>3.1</td>
<td>The need to reduce dependence on fossil fuels in the transport sector</td>
<td>4 8 12 24</td>
</tr>
<tr>
<td>3.2</td>
<td>Renewable energy sources and energy efficiency - conditions for sustainable transport development</td>
<td>2 4 4 16</td>
</tr>
<tr>
<td>3.3</td>
<td>Energy efficiency conditions for road and rail transport</td>
<td>4 4 12 16</td>
</tr>
<tr>
<td>3.4</td>
<td>Low carbon green transport strategy</td>
<td>4 4 12 16</td>
</tr>
<tr>
<td>3.5</td>
<td>Energy Efficiency Cooperation Programs in the Asia-Pacific Region</td>
<td>4 8 24 36</td>
</tr>
<tr>
<td>4</td>
<td>Gender representation in transport</td>
<td>18 28 64 80</td>
</tr>
<tr>
<td>4.1</td>
<td>Global gender inequality and transport</td>
<td>4 8 12 12</td>
</tr>
<tr>
<td>4.2</td>
<td>Impact of the COVID-19 crisis on pressing gender issues</td>
<td>2 4 4 8</td>
</tr>
<tr>
<td>4.3</td>
<td>Women's mobility patterns based on social, economic and geographic factors</td>
<td>4 4 12 12</td>
</tr>
<tr>
<td>4.4</td>
<td>The causal connection of low retention rates for women in jobs in the transport sector and ways to improve these indicators</td>
<td>4 4 12 12</td>
</tr>
<tr>
<td>4.5</td>
<td>Incorporating Gender Issues into Transport Projects</td>
<td>4 8 24 36</td>
</tr>
<tr>
<td>5</td>
<td>Safe and inclusive transport and mobility</td>
<td>18 28 64 80</td>
</tr>
<tr>
<td>5.1</td>
<td>Safety in the field of road, rail and sea transport</td>
<td>4 8 24 36</td>
</tr>
<tr>
<td>5.2</td>
<td>Transport poverty and its connection to the road safety complex</td>
<td>4 4 12 12</td>
</tr>
<tr>
<td>5.3</td>
<td>Inclusive transportation for people with disabilities and ways to increase mobility</td>
<td>4 4 12 12</td>
</tr>
<tr>
<td>5.4</td>
<td>Strategies for tackling poor driving and speed control for road safety</td>
<td>4 8 12 12</td>
</tr>
<tr>
<td>5.5</td>
<td>ESCAP countries’ initial response to the COVID-19 crisis</td>
<td>2 4 4 8</td>
</tr>
<tr>
<td>6</td>
<td>Transport safety and working conditions</td>
<td>22 32 72 212</td>
</tr>
<tr>
<td>6.1</td>
<td>Strategic Directions for Transport Safety</td>
<td>2 4 4 36</td>
</tr>
</tbody>
</table>
Section 1. Socio-economic and environmental aspects of transport (Asian Highway networks, Trans-Asian Railway networks and dry port networks)

28. The concept of sustainable development is based on the achievement of a reasonable balance between environmental, economic, social, cultural development and the needs of people.

29. An important role in ensuring sustainable development belongs to the transport system, since, on the one hand, transport is the most important tool for solving social, economic and technological problems, and on the other, its functioning is accompanied by a negative impact on the environment, the occurrence of road accidents, and damage to health. The rapid growth of international economic relations is marked by a radical shift in the system of world trade centers, where the countries of the Asia-Pacific region have taken the leading positions.

30. The purpose of studying this section is to form students' appropriate worldview and knowledge in the field of social, economic and environmental development of transport in the countries of the Asia-Pacific region, as well as to substantiate the role of transport in achieving sustainable development goals.

31. There is no separate sustainable development goal for transport. The study of this section will allow students to implement in their practice the following sustainable development goals:

- Goal 3. Ensure healthy lives and promote well-being for all at all ages
- Goal 7. Ensure access to affordable, reliable, sustainable and modern energy for all
- Goal 9. Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation
- Goal 11. Make cities and human settlements inclusive, safe, resilient, and sustainable

32. The study of the section is aimed at gaining knowledge in the fields of
efficiency of the functioning of logistics systems, reduce the harmful impact on the environment and achieve sustainable development goals;

- the main aspects of the implementation of the Intergovernmental Agreement on the Asian Highway Network, the configuration of the coverage of the Asian Highway network, the classification of highways by road category and with ESCAP projects to develop mechanisms for the management of selected intermodal transport corridors in Asia, helping countries to stay ahead of their national transport policies, taking into account more broad regional perspective;
- the latest developments in the Trans-Asian Railway network, unresolved issues and further steps that will make this network even more effective in promoting regional cooperation and integration for sustainable development;
- measures taken and being taken to strengthen interregional sustainable transport connectivity in the context of the development of dry ports of international importance, integrated intermodal transport and logistics, including infrastructure connectivity, operational connectivity, and experience in the creation of dry ports accumulated by developed countries and adopted by ESCAP countries;
- measures to achieve the Sustainable Development Goals in terms of the development of environmental sustainability of transport, the construction of environmentally friendly, competitive, sustainable and inclusive transport systems.

33. The development of efficient, economically viable and secure transport and logistics systems can provide alternative or complementary transport connections to maritime transport, facilitate existing and future trade and freight flows between Asia-Pacific countries, and facilitate the integration of national economies into the global economy.

34. As a result of growing energy demand and emissions in the transport sector, as well as the rapid emergence of new technologies, the concept of sustainable transport systems is gaining acceptance. According to the Organization for Economic Co-operation and Development (OECD), an environmentally sustainable transport system is one in which transport does not threaten public health or ecosystems. Environmentally sustainable development of the transport system is one of the fundamental conditions for ensuring sustainable mobility and promoting the development of more efficient transport systems.

**Topic 1.1 Road transport on the Asian Highway network**

**Content**

35. Intergovernmental Agreement on the Asian Highway Network. Infrastructure connectivity within the Asian Highway Network: Qualitative and Quantitative Characteristics of Highways in Asia by subregions. Operational Connectivity in the Asian Highway Network: A Regional Strategic Framework for International Road Transport Facilitation. Measures to further develop the Asian Highway network as a tool to support sustainable growth in the region. The national road transport system, taking into account the peculiarities of its functioning, climatic characteristics and geography of the area.
**Topic 1.2 Rail transport on the Trans-Asian Railway network**

Content

36. Intergovernmental Agreement on the Trans-Asian Railway Network. Infrastructure connectivity in the Trans-Asian Railways network: developing old and opening of new traffic routes, missing links in the network by subregion, cost-effective and regular maintenance of an extensive regional network. Operational connectivity in the trans-Asian railway network: problematic issues of network operation. Creation of railways in the framework of solving the problem of overall logistics - rail transportation as part of the overall logistics solution. Competitiveness of rail transport within the Trans-Asian Railway network. The national system of railway transport, taking into account the peculiarities of its functioning, climatic features and geography of the area.

**Topic 1.3 Dry ports and intermodal facilities in the Asia-Pacific region**

Content


**Topic 1.4 Sustainable transport systems**

Content

Section 2. Use of alternative fuels and new powertrain technologies (road and rail)

39. Section 2 addresses the use of alternative fuels and new powertrain technologies, in line with Goal 7. Ensure access to affordable, reliable, sustainable and modern energy for all and Goal 13. Take urgent action to combat climate change and its impacts.

40. The global transport sector is actively discussing the agenda for creating energy strategies and plans aimed at ensuring energy security and meeting energy demand, in accordance with the pace of economic growth, the growth rate of population and urban agglomerations.

41. The social and economic development of the ESCAP countries in the long term is ensured by the efficiency of fuel and electricity costs. Energy efficiency issues are being considered in close connection with environmental aspects, as well as the possibility of increasing domestic production of renewable energy and energy production using high-performance technologies.

42. The main issue for the use of alternative fuels is to reduce the impact on the environment and society. As for fuel combustion, the transport sector accounts for 24 percent of direct carbon dioxide emissions, and as for consumption of fuel, it ranks third in terms of carbon dioxide emissions in the region.\textsuperscript{vi} Road transport, which is still a popular mode of transport in passenger and freight traffic, accounts for over 75 percent of transport carbon dioxide emissions.

43. Mandatory fuel efficiency standards play a key role in improving the efficiency of road and rail transport. Carbon taxes have only a limited impact on the cost of mobility. The decarbonization of the transport sector is expected to be driven by changes in consumer preferences, coupled with the speed of innovation and commercialization of new technologies such as electric vehicles, biofuels and hydrogen. Urban transport modernization can be accomplished through proper planning of urban infrastructure and transport efficiency. One of the most serious problems is heavy transport due to the volume and complexity of the transport system.

Topic 2.1 Current state and development paths of alternative fuels and new powertrain technologies for road and rail transport in the Asia-Pacific region

Content

44. Fuel and energy balance. Focus on reducing energy consumption. Harmful effects of traditional energy on the environment. Traditional and non-traditional energy sources. The place of non-traditional sources in meeting human energy needs. Energy reserves and consumption dynamics, the policy of the APR countries in the field of non-traditional and renewable energy sources. Hydroelectric power plants: principle of operation, advantages and disadvantages. Nuclear power plants: fast and slow neutron reactors, closed technological cycles in nuclear power. Reactor protection measures, reduction of nuclear

**Topic 2.2 Environmental aspects of using alternative energy sources**

Content

45. Environmental problems associated with the development of energy, ways to reduce the harmful effects on the environment. Possible alternative fuels, new powertrain technologies and reasons limiting their use. Environmental consequences of the development of solar energy. The impact of wind energy on the environment. Possible ecological manifestations of geothermal energy. The environmental impact of using ocean energy. Ecological characteristics of the use of bioenergy installations. The need to use alternative energy and renewable energy resources.

**Topic 2.3 Alternative fuels in road and rail transport**

Content


**Section 3. Energy efficiency of transport (road and rail) (under SDG 7 Affordable and clean energy)**

47. The third section of the program examines the energy efficiency of transport (road and rail), which corresponds to the implementation of the 7th goal of sustainable development "Affordable and Clean Energy".

**Topic 3.1 The Need to Reduce Dependence on Fossil Fuels in the Transport Sector**

Content

48. The predominance of fossil fuels in the global energy balance. The share of transport in the global demand for petroleum products. Forecast of the growth rates of renewable and nuclear energy. Climatic prerequisites for reducing the share of fossil fuels in the structure of the world fuel and energy balance. Technological breakthroughs and innovations that reduce hydrocarbon emissions. Demographic changes
causing changes in energy consumption patterns. Informed and able to connect with each other, consumers want more information about the environmental consequences of using certain products. The environmental consequences of the enterprise's activities are important for the consumer.

**Topic 3.2 Renewable Energy Sources and Energy Efficiency - Conditions for Sustainable Transport Development**

Content:

49. Climate change and resource scarcity stimulating the development of renewable energy sources. The spread of joint consumption ("car sharing") and other environmentally friendly transportation options (rail, electric vehicles, bicycles, scooters, etc.) Transport companies with a reputation for being environmentally sustainable have a competitive edge.

**Topic 3.3 Energy efficiency conditions for road and rail transport**

Content


**Topic 3.4 "Low carbon green transport strategy"**

Content

**Topic 3.5 Energy Efficiency Cooperation Programs of the Asia-Pacific Region**

Content

52. Conditions that support the demand for cleaner energy. Parameters of countries’ movement towards a cleaner world. Encouraging governments to move towards clean energy. Technological breakthroughs in battery technology.

**Section 4. Gender representation in the transport sector**

53. This section examines the issues of global gender inequality, its reflection in transport, women’s mobility patterns taking into account social, economic and geographic factors, the causes and consequences of low rates for women in jobs in the transport sector. The section also addresses the inclusion of gender issues in transport projects, as well as the impact of the COVID-19 crisis on pressing gender issues. The topic of gender is in one way or another related to all the goals of sustainable development. Gender equality and the empowerment of women are recognized as essential contributions to the achievement of all goals and targets. However, the study of gender distribution in transport is aimed at achieving Goal 5, which deals with gender equality. Gender equality is not only a fundamental human right, but also an essential foundation for peace, prosperity and sustainable development. The main purpose of this training module is to highlight the problem of gender inequality in the EXATO countries in general and issues of gender distribution in transport in particular. Overall, the module shows the importance of approaching transport through a gender prospective. It addresses not only theoretical aspects, but also contains recommendations for addressing gender issues at all stages of inclusion in transport projects.

**Topic 4.1 Global Gender Inequality and Transport**

Content


**Topic 4.2 Impact of the COVID-19 crisis on pressing gender issues**

Content

55. The consequences of the COVID-19 pandemic could undo the limited progress that has been made on gender equality and women's rights. The coronavirus outbreak is exacerbating existing inequalities for women and girls in everything from health and the economy to safety and social protection. Participants will be introduced to the proposed COVID-19 response, which includes the following aspects:
• Including women and women’s organizations in the planning and decision-making process for the response to COVID-19;
• transforming unfair unpaid care work into a new, inclusive “economy of care” that benefits all;
• the development of socio-economic plans, focused on the lives and future of women and girls.

**Topic 4.3 Women's mobility patterns based on social, economic and geographic factors**

Content

56. The concept of “trip-chaining” of women in public transport, the dependence of gender differences in mobility and access on the cost of transport services. Global Roadmap for Sustainable Mobility, Women’s Access to Transport. Rural and urban travel patterns of women in developing countries. “Gender Blind” Transport Planning Programs to increase the number of women working in the field of transport design, planning and decision-making in the Asia-Pacific region and ESCAP countries.

**Topic 4.4 The causal connection of low retention rates for women in jobs in the transport sector and ways to improve these indicators**

Content:

57. Barriers to women’s participation in transport work. Causes and consequences of low retention rates of women in jobs in the transport sector and ways of solving this problem. National features of the legislation in the field of admission of women to work in the transport sector by mode of transport.

**Topic 4.5 Incorporating Gender Issues into Transport Projects**

Content

58. Business rationale for the need to include gender equality in transport policies and projects. Benefits of integrating gender considerations into the design and implementation of ESCAP transport projects. Improving access to markets, education, employment and health care for women. Employment of women and the use of women’s enterprises in the construction and maintenance of infrastructure projects. Increase the number of women in the transport industry to improve the safety of public transport for women workers and passengers.

**Section 5. Safe and Inclusive Transport and Mobility**

59. Road safety is a sustainable development challenge for the Asia-Pacific region. Ensuring safe, affordable, accessible and sustainable transportation for all by 2030 is a challenge by improving road safety, in particular increased use of public transport, with particular attention to the needs of those in vulnerable situations, women, children, the disabled and the elderly. Studying the issues of safe and
inclusive transport and mobility will allow the leaders of the transport sectors of ESCAP countries to implement the following sustainable development goals set by the UN in their practice:

- Goal 3: Ensure healthy lives and promote well-being for all at all ages
- Goal 10: Reduce income inequality within and among countries
- Goal 11: Make cities and human settlements inclusive, safe, resilient, and sustainable
- Goal 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels

60. The purpose of this section is to show participants that transport and mobility can contribute to poverty reduction and equitable and inclusive social development in Asia and the Pacific. Safe and reliable transport infrastructure and services that enable people and goods to reach their destinations at reasonable cost and time is essential for economic growth and for a balanced distribution of economic and social benefits, and for ensuring that the environmental impact of human development is properly managed.

**Topic 5.1 Safety in the field of road, rail and sea transport**

Content

61. Background information on the road safety situation, WHO data on road accidents, the importance of improving road safety in the ESCAP region, rail and maritime transport safety (regional initiatives and activities that were carried out in the ESCAP region).

**Topic 5.2 Transport poverty and its connection to the road safety complex**

Content


**Topic 5.3 Inclusive transport for people with disabilities and ways to increase mobility**

Content

63. Statistics and documents on the rights of people with disabilities in ESCAP countries. Lack of mobility, economic and social consequences. Affordable and sustainable transport systems for people with disabilities and other vulnerable groups. Examples of Disability Inclusive Transport Measures. Taking
into account the mobility needs of people with disabilities in transport development strategies and urban planning.

**Topic 5.4 Strategies for tackling poor driving and speed control for road safety**

**Content**

64. Connection between road safety and speed control in ESCAP member States. Challenges in ESCAP member countries regarding speed management. ESCAP member countries' ability to manage speed. Speed reduction measures taken by ESCAP member countries. Speed management in ESCAP member countries. Road modifications to reduce speed. Safer cars. Good practice in reducing alcohol-related accidents. Driving rules for young drivers. Social Marketing and Public Education. Frequent, visible and public enforcement of driving violations. Effective sanctions for driving offenders.

**Topic 5.5 ESCAP countries' initial response to the COVID-19 crisis**

**Content**

65. Regional transport links during and after a pandemic. Using regional transport cooperation to reduce the risks of the functioning of the transport system in a pandemic, emergency or natural disaster. Digitalization of processes related to the exchange of information, operational and regulatory control over the work of transport.

**Section 6. Transport safety and working conditions**

66. In the 6th section of the program, working conditions in various modes of transport are studied, metrics for measuring the quality of the working environment and the world's best practices in the ergonomics of the transport sector, the organization of the transportation of hazardous goods by various modes of transport, the basics of the safety of workers operating in various modes of transport. The study of these issues is fully aimed at realizing the following sustainable development goals:

- Goal 3. Ensure healthy lives and promote well-being for all at all ages
- Goal 8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
- Goal 9. Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation

67. Transport companies as backbone elements of the economy and the largest employers in the Asia-Pacific region prioritize compliance with the principles of sustainable development and implementation of social responsibility programs for workers, society and the state. To halve the number of deaths and injuries from road traffic accidents, transport companies are joining the international zero-injury movement.
68. Additions have been made to their corporate policies in terms of taking measures to prevent work-related injuries, deteriorating health and introducing safety culture in production processes.

69. The development of corporate culture through the formation of sustainable safety skills at all stages of the transportation process of end-to-end technologies of value chains provides for the implementation of training programs for personnel, seminars and trainings, as well as the creation of a system for monitoring the level of safety culture in all modes of transport.

70. When studying this topic, the best world practices are considered for the implementation of a set of measures to ensure safety and labor protection at the objects of the transport complex. Participants in the transport sector of the economy assume a transition from compensation for losses to workers to their prevention - the maximum reduction in the frequency of exposure to workers, production risks, harmful and dangerous factors.

The priority for the transport market participants is:

- transition from the compensatory scenario of reimbursement of health losses by workers to the preventive-minimizing scenario of reducing the frequency of exposure to harmful and dangerous factors, production risks in the implementation of work functions.
- minimizing of the presence of workers in areas of increased risk of injury potential at facilities of various types of transport.

**Topic 6.1. Strategic Directions for Transport Safety**

**Content**

71. Strategic principles of safety management in the transport sector and peculiarities of their implementation in the transport systems of the Asia-Pacific region. Prioritizing safety over commercial efficiency goals, in line with customer expectations. Development of security monitoring technologies at transport infrastructure facilities in accordance with the condition of maintaining the margins of transportation. Continuous and reasonable updating of standards and technologies for updating and maintaining transport infrastructure in good condition to reduce the risk of injury. Improving the security of transport systems in urban agglomerations, including licensing of taxi and private bus fleets. Improvement of control and supervision activities over small aircraft flights, civil aircraft flight control system in accordance with international rules. Improvement of the system of preventive maintenance plans, taking into account the actual state and predictive analytics of disruption of the technical means of transport.
**Topic 6.2. Working conditions in transport**

Content

72. A set of factors of the working environment and the labor process that affect the performance and health of an employee. Hazardous production factors, the impact of which on the employee can cause illness. Hazardous production factors, the impact of which on the worker can cause injury. Safe working conditions. The main factors of harm to the health of transport workers and protective measures: electrical safety, noise, vibration, critical temperatures, exposure to hazardous chemical environments, etc. Analysis of injuries and occupational diseases and the development of proactive measures. Features of labor regulation of transport workers. Working time and rest time of employees whose work is directly related to the movement of vehicles. Discipline of employees whose work is directly related to the movement of vehicles. Organization of jobs in the transport industry by type of transport. Employer’s control over the condition and safety of the workplace. Personal and collective protective equipment for workers from harmful and (or) hazardous production factors, as well as protection against pollution. Occupational health and safety management system, health and safety policy and objectives, and procedures to achieve these goals.

**Topic 6.3. Fundamentals of the safety of workers operating on various types of transport**

Content

73. Risks and threats to the safety of workers by mode of transport in national transport systems. Measures to reduce exposure to hazardous chemicals, pollution of air, water and soil. Measures to reduce the psychological stress of the dispatch staff, machinists, drivers, ship crew, pilots, taking into account the specifics of their work schedule and working conditions. Labor protection programs, systems for preserving the life and health of workers in the working process, including legal, socio-economic, organizational and technical, sanitary and hygienic, treatment and prophylactic, rehabilitation measures. Measures aimed at meeting the requirements of fire safety, industrial safety, etc., in the course of the labor activity of employees. Organizational and legal basis for ensuring transport safety. Obligations of the employer and employee. Responsibility for violation of labor protection and safety requirements.

**Topic 6.4. Transportation of hazardous goods by various types of transport.**

Content

of organizing the transportation of dangerous goods by various modes of transport. Labor protection rules for the transport of dangerous goods. Rules for the carriage of dangerous goods.

**Topic 6.5. Innovative technologies to ensure safety and comfortable conditions for carrying out activities in transport**

**Content**

75. Smart, sustainable and secure infrastructure for drones in all modes of transport. Reduction of production areas with a hazardous nature of production activities in transport. Elimination of the human factor in the management of the transport complex, robotization of technological processes. Online monitoring of transport infrastructure facilities and video surveillance. Innovative solutions for creating a comfortable environment for the workplace of transport workers, excluding the impact on the worker's body of ultrasound, electromagnetic and ionizing radiation, industrial lighting, the basics of fire safety. Exclusion of a person from danger zones in transport. Expanding the scope of industrial robotic loaders for loading / unloading and moving at transport facilities.

**Section 7. Elimination of losses in the transport system (under SDG 12 Responsible Consumption and Production)**

76. This section of the program examines the issues of eliminating losses in the transport system and introducing effective methods of process management, which corresponds to the implementation of the 12th goal of sustainable development - ensuring sustainable consumption and production patterns.

77. Given the continuous growth of the world's population and the concentration of living in resource-intensive urban areas, in the face of limited resources of the Earth, it is necessary to operate sustainable energy-saving patterns of consumption and production.

78. Since the middle of the 20th century, the concept of Lean production has been actively used in industrial enterprises around the world, based on the constant identification and reduction of losses - an activity that consumes resources, but does not bring value. The application of this concept in various areas of the economy and life of the world's population can become one of the prerequisites for sustainable development in the future. Lean production starts with respect for employees and considers any production from the point of view of process optimization by all employees of the company.

79. This section tells the audience about what production systems in transport are and how they affect the efficient use of natural resources, reduction of environmental pollution through preventive measures, waste reuse, etc. Also, the course will highlight the issue of transport losses resulting from irrational production patterns that lead to depletion of natural resources, unnecessary food waste, and high levels of carbon emissions. Methods for reducing losses in transport will be highlighted as tools for
rational consumption and production patterns, leading to increased efficiency and productivity of labor, rolling stock and equipment. The course will highlight the issues of assessing the effectiveness of measures to reduce losses and leadership in transport, necessary for the implementation of rational consumption and production patterns.

**Topic 7.1 Production systems in transport**

Content

80. Process model of transport organization. Production system - a set of methods for managing the production process, aimed at the continuous elimination of waste and non-productive costs. The implementation of a production system in a company must be accompanied by the involvement of all employees of the company with a maximum focus on customer needs. Differences between a transport enterprise and the organization of industrial production. Highlighting the processes of the transport company that create value in the transport activities. Production and economic indicators of the transport company, taking into account the identification of losses.

**Topic 7.2 Types of losses and non-production costs**

Content

81. The criterion for continuous business improvement is the value of transport products for the final consumer - the client (shipper / consignee). Elements of the value of transport products. 2 types of consumers (clients) of processes and products of the organization of transport. Analysis of the value of the processes of the transport company from the standpoint of various stakeholders. Losses are processes and operations that do not add value to the client, while these activities consume significant resources - financial, labor and fuel and energy. The peculiarities of the organization of transport contribute to the occurrence of losses of various levels. Loss of the upper level (macro). Industry losses. Low level loss (micro). Loss types.

**Topic 7.3 Ways to reduce losses in transport**

Content

82. The main tools of the production system: standardization, value stream mapping, Ishikawa diagram, pull production, kanban, workspace organization (5S), visualization, quick changeover, error protection, total equipment maintenance, loss nomenclature, Pareto chart, just in time. The most important tools are value stream mapping and application of a typical waste nomenclature. Loss detection cycle. Formation of measures to eliminate losses in the transport company.
**Topic 7.4 Approaches to assessing loss-reduction activities**

Content

83. Analysis of the economic essence of losses in the activities of the organization of transport. Loss reduction factor. Determination of economic standards of operations in the processes of organizing transport. Determination of the process regulated by the economic standard. Determination of the consumer of the process. Identifying the operations that make up the process or detailing the process into sub-processes. Determination of indicators of process operations. Determining the waiting time between process operations. Determining value stream suppliers. Identifying activities that add or do not add value to the process. Adjustment of the economic standard. Optimization of labor costs of transport workers, as well as the volume of movement of rolling stock.

**Topic 7.5 Lean production and leadership on transport**

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