

РОЗВИТОК ІННОВАЦІЙНОЇ І СТАЛОЇ ІНФРАСТРУКТУРИ: ДОСВІД ЄВРОПЕЙСЬКОГО СОЮЗУ

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Проаналізовано сучасні наукові підходи до дослідження проблем створення інноваційної інфраструктури у країнах світу у контексті сталого зростання як найсуттєвішого аттрактора розвитку міжнародної економіки. Розкрито ключові тенденції й особливості формування інноваційної і сталої інфраструктури на наднаціональному і національному рівнях у межах Європейського союзу. Запропоновано рекомендації щодо формування інноваційної і сталої інфраструктури в Україні в умовах її інтеграції до Європейського союзу.

Ключові слова: сталий розвиток, інновація, зелена інфраструктура, навколишнє середовище, Європейський союз.

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INNOVATIVE AND SUSTAINABLE INFRASTRUCTURE DEVELOPMENT: BEST EU PRACTICES

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A drastic deterioration in environmental performance of developed countries as well as emerging markets triggered off by devastating resource usage, environmentally and socially intolerant economic behavior has turned national-level goal of greening and socializing economic growth into a worldwide challenge of utmost importance. Innovative and sustainable infrastructure plays a pivotal role in the sustainable development concept implementation at all levels. In the article academic approaches to the innovative infrastructure are examined in the light of sustainable development as a key world economy attractor.

The author investigates latest trends and features of the EU infrastructure modernization. The infrastructure performance of the EU Member-States has been rather strong and innovative of late but not permanently sustainable. Thus amongst many terms used to outline a final and expected result of infrastructure renovation – sustainable, innovative, green infrastructure – the last one aimed at ensuring eco-friendly economic effects as well as non-environmental benefits is supposed to be the most applicable to the modern EU context.

Green infrastructure goals have been incorporated into all main supranational policy frameworks of the European Union since Green Infrastructure Strategy «Green Infrastructure – Enhancing Europe's Natural Capital» was adopted in May 2013. To meet decarbonization challenges and integrate new Member-States into intra-EU economic affairs the European Union prioritize greening energy and transport infrastructure. Active civil society dialogue on green infrastructure issues is ensured by a variety of NGOs represented at all EU levels and via a number of on-line platforms.

France, Germany, Austria, Belgium and Finland are the EU leaders in terms of innovative infrastructure. However the world economic crisis has negatively impacted the infrastructure financing. After the World War II the public sector was a key investor in

infrastructure across Europe. Nowadays public sector investments in infrastructure have dropped, the total number of public-private projects is low as well.

Considering the EU green infrastructure trends and features the author works out recommendations to create sustainable and innovative infrastructure system in Ukraine.

Key words: sustainable development, innovation, green infrastructure, environment, European Union.

Introduction. Nowadays the sustainability of growth is a key landmark of the world economic development. The European Union has turned to the sustainable development (SD) concept implementation since SD attributes were set out at the UN Conference on Environment and Development in Rio de Janeiro (Brazil) in 1992. As a result sustainable development goals are presently incorporated into all main policy areas of the European Union and notwithstanding the world economic and financial crisis SD prioritization enhancement still remains a fundamental trend in the majority of the EU Member-States. Therefore the sustainability is supposed to be the central challenge for the EU potential candidates and the EU partner countries on their way to the European Union.

Being highly EU-oriented Ukraine attempts to strike the balance between economic and environmental challenges today in order to meet the EU accession criteria. In this light, an important obstacle to Ukraine's integration into the European Union is outdated and unsustainable infrastructure representing one of the many Soviet legacies. Considering all these contextual issues Ukraine should pay respect to the European Union sustainable growth policies and benefit from the best practices of the EU Member-States in the field of innovative and sustainable infrastructure.

Literature review. Fundamental research on infrastructure development has recently been conducted by D. Abraham, J. Adamowski, H. Ammermann, E. Badu, P. Beauchamp, M. A. Benedict, C. Bo, D. M. Brown, J. Carter, C. Davies, D. J. Edwards, J. Egerer, J. Ehlers, A. R. Ennos, M. Faehnle, M. Florio, J. Foster, M. Frenz, J. Gaventa, C. Gerbaulet, S. E. Gill, B. Hammerli, J. F. Handley, K. Henle, I. Holmes, H. Huang, Z. Hudekova, A. Kazmierczak, C. C. Konijnendijk, R. Laforteza, R. Lambert, C. Lorenz, A. Lowe, N. Mabey, E. T. McMahon, I. C. Mell, A. Mostafavi, M. Mukherjee, D. Owusu-Manu, S. Pauleit, S. Pickford, R. Puentes, A. Renda, P. Sabacchi, C. Sullivan, G. Sanesi, D. Tentori, J. Thompson, S. Tomlinson, S. Winkelmann etc. [1–22].

In academic papers of mentioned authors general issues and tools of infrastructure development – transport and energy infrastructure modernization, innovation dynamics and infrastructure challenges, collaborative planning of urban infrastructure – are examined; infrastructure financing features and attributes (assessment of innovative financing policies, ways of improving infrastructure financing and new financial schemes for different infrastructure projects) in the EU Member-States as well as other countries are revealed; green infrastructure development goals and challenges are outlined.

Although in modern economic theory there exists a wide range of academic approaches to the infrastructure development, the majority of the authors either restrict the scope of research with a single or several national economies or examine this issue without focusing on sustainability and world economy environmental challenges so that overall trends and factors of sustainable infrastructure still remain confusing.

Purpose of academic paper. The article aims at revealing EU key innovative and sustainable infrastructure development trends and features in order to work out recommendations to create green and competitive infrastructure system in Ukraine.

Key results. Present-day Ukraine is wracked by devastating war, deepening poverty and social inequality; country's economic, environmental and social indicators continue to deteriorate; cities of Ukraine still remain outdated and eco-unfriendly: no sustainable waste and water management systems, no integrated transport system and green energy infrastructure. To improve economic, social and environmental performance Ukraine urgently needs comprehensive reforms and innovations. In this light, infrastructure reformatting is considered to be a pivotal step forward for Ukraine's European integration, well-being enhancement, job creation. Indeed, infrastructure modernization has a wide range of favorable and potentially beneficial implications for all the sustainable development dimensions. Hence, there is no question

that Ukraine's infrastructure system urgently needs to be substantially reformatted but the question remains as to which policy measures and tools to be selected for such an ambitious goal implementation.

Economic theory doesn't have an exact answer to this question. However investigating theoretical background of infrastructure development one should conclude that current research in this field can be broadly split into three substantive categories:

- the first one represented by C. Bo, J. Egerer, M. Florio, M. Frenz, J. Furman, C. Gerbaulet, B. Hammerli, R. Lambert, C. Lorenz, M. Porter, L. Safiullin, R. Shaidullin, M. Shigabieva, S. Stern, A. Renda, D. Ulesov etc [6; 9; 14; 16; 24; 25] comprises the studies on general issues and tools of infrastructure development – transport and energy infrastructure modernization, innovation dynamics and infrastructure challenges, collaborative planning of urban infrastructure etc – without focusing on interconnections between sustainability and infrastructure;

- the keynote of the second group approaches introduced in studies of D. Abraham, H. Ammermann, K. Bodewig, E. Christophersen, J. Clements, P. Davis, J. Ehlers, J. Gaventa, I. Holmes, H. Huang, A. Juliana, N. Mabey, A. Mostafavi, S. Pickford, R. Puentes, P. Sabacchi, C. Secchi, L. Sihombing, C. Sullivan, D. Tentori, J. Thompson, S. Tomlinson [1; 3; 10; 15; 18; 22; 26–28] is infrastructure financing (assessment of innovative financing policies, ways of improving infrastructure financing and new financial schemes for different infrastructure projects) in the EU Member-States as well as in other countries;

- the third group combines academic papers of J. Adamowski, E. Badu, P. Beauchamp, M. A. Benedict, D. M. Brown, J. Carter, C. Davies, D. J. Edwards, A. R. Ennos, M. Faehnle, J. Foster, S. E. Gill, J. F. Handley, K. Henle, Z. Hudekova, A. Kazmierczak, C. C. Konijnendijk, R. Laforteza, A. Lowe, E. T. McMahon, I. C. Mell, M. Mukherjee, D. Owusu-Manu, S. Pauleit, G. Sanesi, S. Winkelman etc [2; 4; 5; 7; 8; 11–13; 17; 19–21] based on green infrastructure (GI) as a central criteria for modern development efficiency assessment.

Although the objects of the mentioned academic papers vary all of them emphasize the importance of infrastructure modernization, its innovativeness enhancement in developing countries as well as in developed ones. At the same time the EU Member-States infrastructure performance has already been rather strong and «innovative» of late (Table 1) while other sustainable development indicators are not so sound in comparison with some non-EU countries (Table 2). Thus for the European Union it is far more crucial and urgent to enhance its infrastructure sustainability and eco-tolerance.

Amongst the many terms used to outline a final and expected result of infrastructure modernization – sustainable, innovative, green infrastructure – the last one, although being a recently introduced term (the EU Green Infrastructure Strategy «Green Infrastructure – Enhancing Europe's Natural Capital» as an independent strategy was adopted in May 2013), is supposed to be the most applicable to the modern EU context considering looming environmental threats. The European Commission defines green infrastructure as a strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services [32, p. 3].

Table 1

Infrastructure and Innovation Performance of Developed Countries*

<i>EU / non-EU</i>	EU Member-States			Non-EU countries			
<i>Indicator / Country</i>	<i>Sweden</i>	<i>Denmark</i>	<i>Germany</i>	<i>Switzerland</i>	<i>USA</i>	<i>Canada</i>	<i>Japan</i>
The Global Competitiveness Index 2014-2015, rank Pillar 2. Infrastructure	22/144	21/144	7/144	5/144	12/144	15/144	6/144
The Global Competitiveness Index 2014-2015, rank Pillar 12. Innovation	7/144	11/144	6/144	2/144	5/144	22/144	4/144
Innovation Index 2013	145	139	133	156	117	79	113
Quality of trade and transport related infrastructure 2014	4,09	3,82	4,32	4,04	4,18	4,05	4,16

*Source: [29, p. 16, 20; 30, p. 33–34, 37, 46–47, 69, 73; 31].

Key modern trends and features of the EU innovative and sustainable infrastructure development are the following:

- *In fact, the term «green infrastructure» stands for sustainable and innovative infrastructure in the present-day EU context.* At first biodiversity conservation was considered to be the only goal of the GI concept popularization. However nowadays European researchers divide ecosystem services into three groups – provisioning services (food, water); regulating services (air quality regulation, erosion prevention, climate regulation, coastal protection); cultural services (recreation) [12, p. 18; 33, p. 520]. Therefore the EU context gives evidence that green infrastructure development is meant to ensure eco-friendly effects as well as non-environmental favorable impacts on the EU economic system today. In other words, green infrastructure is supposed to be sustainable as well as innovative;

Table 2

Sustainability Performance of Developed Countries*

<i>Indicator / Country</i>	France	Germany	Norway	Switzerland	Iceland	Australia	Sweden
Index of Sustainable Development 2013, rank	17/112	11/112	4/112	1/112	3/112	5/112	2/112
Gross National Income per capita 2014 (\$)	42560	46251	100898	84748	47349	67463	60380
Environmental Performance Index (EPI) 2014, rank	27/178	6/178	10/178	1/178	14/178	3/178	9/178
Primary Energy Supply 2012: Renewables (% of total)	52,4	20,4	47,8	49,7	84,7	4,6	70,5
Human Development Index (HDI) 2014, rank	20/187	6/187	1/187	3/187	13/187	2/187	12/187
Life expectancy at birth in 2013, years	81,8	80,7	81,5	82,6	82,1	82,5	81,8

*Source: [31; 34; 35, p. 160, 212; 36, p. 10].

- *GI goals and priorities have been incorporated into all the key supranational policy frameworks of the European Union since Green Infrastructure Strategy «Green Infrastructure – Enhancing Europe’s Natural Capital» was adopted in May 2013:* Europe 2020; EU Policy Framework for Climate and Energy in the period from 2020 to 2030; EU Waste Framework Directive; Resource Efficiency Roadmap; EU Biodiversity Strategy; Natura 2000. At the national level this trend is not univocal across the EU: for instance, in France there exists a national framework for green and blue infrastructure focusing on biodiversity and ecological connectivity issues; the UK has the most comprehensive approach to the GI principles adoption and local GI planning [17]; in Czech Republic, Denmark, Germany, Netherlands, Slovakia the establishment of ecological networks is stipulated within national legislation (usually the same legislation transposing Birds and Habitats Directives) [37, p. 5];

- France, Germany, Austria, Belgium, Finland are *the EU leaders in terms of innovative infrastructure*. However one should note that the world economic crisis has negatively impacted the infrastructure financing across the EU. After the World War II the public sector was a key investor in infrastructure in Europe. Today the total number of public-private projects remains low, the only exception is the UK with more than 30 projects concluded in 2013 representing a total volume of EUR 6 billion (compared to Germany's 10 projects amounted to less than EUR 1 billion); but overall trend is unfavorable: since 2007 the number of public-private partnerships in Europe has fallen by almost half. In its turn, Germany’s outstanding level of infrastructure is a result of massive investment programmes undertaken during the 1980s and 1990s but the country’s roads are rapidly deteriorating while investment in renovation and maintenance of existing assets decreased from an average of €12 billion in the early 1990s to less than €10 billion in 2013 (at 2005 prices) [38, p. 14];

- *active civil society dialogue on green infrastructure development issues is ensured by a variety of NGOs represented at all levels – European Green Infrastructure Practitioners' Network, European Environmental Bureau, Swedish Society for Nature Conservation, «Formas», Swedish Environment Institute, «Mistra»; via a number of on-line platforms – European Business and Biodiversity Platform, European Learning Network for Regions and Biodiversity, CEEweb for Biodiversity etc; with a series of public awareness raising campaigns on green and sustainable infrastructure issues (for instance, the Netherlands Live with Water launched in 2003 in Holland);*

- *to put into practice green infrastructure goals and priorities a comprehensive approach to GI implementation is applied in the EU: green infrastructure projects are implemented at all the European Union levels; e.g. at the pan-European level there were launched «European Green Belt» in 2003 (a project aimed at conserving the nature), «Natura 2000» in 1992 (the EU biodiversity conservation network), «Green Surge» in 2013 (a program for biodiversity conservation, spatial planning enhancement); at the regional level – «Alpine-Carpathian Corridor» (an Austria-Slovakia sustainable project); at the local level – «Ekostaden Augustenborg» (Swedish municipal green infrastructure project) etc. In general, to meet decarbonization challenges and integrate new Member-States into intra-EU economic affairs the European Union prioritize greening energy and transport infrastructure.*

Conclusion. In the light of environmental challenges facing the EU amongst many sustainability enhancement policy areas of the European Union green infrastructure seems to be the most potentially beneficial one. To enhance competitiveness and go in line with the EU latest trends Ukraine should reformat its outdated and unsustainable infrastructure.

Taking into account the EU best practices in green infrastructure Ukraine should:

- work out national-level green infrastructure strategy and roadmap;
- encourage the development of local sustainable and innovative infrastructure plans by municipalities across the country;
- incorporate green infrastructure goals and priorities into national government and local authorities key policy areas;
- improve legislative and institutional framework of green infrastructure in order to encourage and facilitate infrastructure financing;
- ensure active civil society dialogue on GI issues by means of launching on-line platforms, organizing meetings and forums;
- establish awareness raising campaigns on key ecosystem services, environmental threats, sustainable development priorities;
- foster public-private cooperation and private sector collaboration with non-governmental organizations at all stages of green infrastructure development.

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