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## CONTENT

<b>BASIC TOOLS OF ENSURING THE ECONOMIC SECURITY OF THE ENTERPRISE (AVANESOVA N., SERHIIENKO Y.)</b>	<b>7</b>
<b>EDUCATIONAL TOURISM AND EDUCATIONAL MIGRATION (BILOTSERKIVSKA O., PETRUSHENKO Y.)</b>	<b>9</b>
<b>COMPARISON OF INTERNATIONAL HUMAN RESOURCE MANAGEMENT MODELS AND THE EXAMPLE OF ITS APPROACH BY MULTINATIONAL COMPANY (BILOTSERKIVSKA O., TARASENKO S., PETRUSHENKO Y.)</b>	<b>11</b>
<b>EDUCATION AND FINANCIAL INCLUSION AS GUARANTEES OF ECONOMIC GROWTH (DIDENKO I., VORONTSOVA A.)</b>	<b>13</b>
<b>CURRENT TRENDS IN THE DEVELOPMENT OF THE INTERNATIONAL REAL ESTATE MARKET (HRACHOVA D., PETRUSHENKO Y.)</b>	<b>15</b>
<b>THE INFLUENCE OF YOUTH ENTREPRENEURSHIP ON THE DEVELOPMENT OF THE REGION ECONOMIC STATE (DYMCHENKO O., SHKURUPIY K., FILINA M/)</b>	<b>17</b>
<b>ECO-PORTS FOR GREEN CITIES (HENS L.)</b>	<b>19</b>
<b>EVOLUTION OF LOGISTICS SYSTEMS. THE ROLE OF LOGISTICS IN INDUSTRY 4.0 (YAREMENKO A., MU JIANMING)</b>	<b>20</b>
<b>PROBLEMS AND PROSPECTS OF SMALL BUSINESS DEVELOPMENT (GLOBA A, VORONENKO V.)</b>	<b>22</b>
<b>REGULATION OF DEVELOPMENT OF RURAL AREAS: EU AND UKRAINE EXPERIENCE (KALINICHENKO S.)</b>	<b>24</b>
<b>PANDEMIC COVID-19 AS A CHALLENGE TO GLOBAL ECONOMIC GROWTH (KASHCHA M., KOLOMIHETS S.)</b>	<b>26</b>
<b>INNOVATION MANAGEMENT: GLOBAL AND CORPORATE CHALLENGES (SABADASH V., KHARCHENKO D.)</b>	<b>28</b>
<b>DIGITAL SOLUTIONS TO MANAGE ENVIRONMENTAL IMPACT: AN OVERVIEW (KOBLIANSKA I.)</b>	<b>31</b>
<b>SOCIAL RESPONSIBILITY OF ENTERPRISES IN THE SYSTEM OF SUSTAINABLE DEVELOPMENT OF THE COUNTRY (KRAVCHENKO O., DMYTRENKO A.)</b>	<b>33</b>
<b>EU POLICIES FOR BUILDING POSTINDUSTRIAL SOCIETY (KUBATKO O. KOVALOV B., ZOLOCHEVSKYI V.)</b>	<b>36</b>

<b>UNITED ENERGY SYSTEM OF UKRAINE: TOWARDS INTEGRATION INTO ENTSO-E (KURBATOVA T., ROMANIUK Y., TRYPOLSKA G.)</b>	<b>38</b>
<b>INTERNATIONAL COOPERATION ON CLIMATE CHANGE: LESSONS FROM THE KYOTO PROTOCOL (KURBATOVA T., YURCHENKO A., LAZIS P.)</b>	<b>40</b>
<b>INTERNATIONAL BUSINESS &amp; MANAGEMENT: ARE WOMEN ON A LEVEL PLAYING FIELD? (KUTSMUS N., USIUK T.)</b>	<b>42</b>
<b>MANAGEMENT OF UTILITIES IN THE CONTEXT OF SUSTAINABLE DEVELOPMENT OF THE CITY (LAVRYK Y.)</b>	<b>44</b>
<b>BENEFITS OF AGRICULTURAL VERTICALLY-INTEGRATED COMPANIES FROM INTEGRATION IN THE GLOBAL VALUE CHAINS (LEVKIVSKYI Y.)</b>	<b>46</b>
<b>INNOVATIVE MARKETING STRATEGIES IMPLEMENTED BY THE EUROPEAN UNION COMPANIES (LISNIAK B., TARASENKO S.)</b>	<b>48</b>
<b>INVESTMENT-INDUCED GROWTH OF AGRICULTURE (MAREKHA I., BONDARENKO S.)</b>	<b>50</b>
<b>DIGITAL TRANSFORMATION STRATEGIES FOR SMALL AND MEDIUM-SIZED BUSINESSES (MELNYK L., DEHTYAROVA I., KACHAN S.)</b>	<b>51</b>
<b>METHODS OF CREATIVE ACCOUNTING AS WAY OF MANIPULATING INFORMATION (SERPENINOVA Y., NOVYKOVA D.)</b>	<b>53</b>
<b>SPATIAL INTEGRATION OF FOREST, AGRICULTURAL AND TOURIST MANAGEMENT ON A LOGISTICS BASIS (MISHENIN Y., YAROVA I.)</b>	<b>54</b>
<b>PROBLEM AND PERSPECTIVES FOR THE DEVELOPMENT OF SMALL AND MEDIUM-SIZED BUSINESS IN THE FIELD OF TOURISM IN UKRAINE AFTR COVID 19 (KASIAN O.)</b>	<b>57</b>
<b>SEED EXPORT TRENDS IN UKRAINE IN THE CONTEXT OF EUROPEAN INTEGRATION (ORLOV V.)</b>	<b>59</b>
<b>PRICE EFFECTS AFTER ABNORMAL RETURNS IN THE DIAMONDS AND STAMPS MARKETS (PLASTUN A., HAVRYLINA A.)</b>	<b>61</b>
<b>MULTIFUNCTIONAL DEVELOPMENT AS A MANAGEMENT APPROACHE OF RURAL DEVELOPMENT (PLOTNIKOVA M., PRYSIAZHNIUK O., SHVETS T., BULUY O.)</b>	<b>63</b>

<b>HROMADAS' PERCEPTIONS OF TREE SHELTERBELTS IN THE CONTEXT OF SUSTAINABLE DEVELOPMENT OF RURAL TERRITORY OF UKRAINE (POPOV A.)</b>	<b>65</b>
<b>FINANCIAL CONDITION OF THE BANKING SECTOR OF UKRAINE: COVID-19 IMPACT (RUDNIAK A.)</b>	<b>67</b>
<b>INVESTMENT RISKS AS A FACTOR OF ECONOMIC SECURITY AND GROWTH OF THE NATIONAL ECONOMY (SABADASH V., SABADASH V.)</b>	<b>68</b>
<b>GENERATIONAL CONFLICT IN MODERN CORPORATE EDUCATION (SEMENENKO T., PROTCENKO O.)</b>	<b>72</b>
<b>THE PANDEMIC IMPACT AND RESPONSE OF INTERNATIONAL ORGANIZATIONS (SHCHERBYNA T., YURCHENKO A.)</b>	<b>73</b>
<b>INTERNATIONAL MIGRATION OF HUMAN CAPITAL (SHCHOKINA E.)</b>	<b>75</b>
<b>SUSTAINABILITY AND VIABILITY OF DEVELOPMENT: PRIORITIES OF KNOWLEDGE-BASED SOCIETIES (SHEVCHUK V.)</b>	<b>77</b>
<b>TERRORISM AS THE GLOBAL THREAT TO SUSTAINABLE DEVELOPMENT (SHKOLA V., PONOMARYOVA L.)</b>	<b>79</b>
<b>SOCIAL SECURITY FOR LABOR MIGRANTS: KEY ASPECTS (SIDELNYK N.)</b>	<b>81</b>
<b>IMPROVEMENT OF ACCUMULATION MECHANISM DEPRECIATION OF FIXED ASSETS (SKORBA O.)</b>	<b>82</b>
<b>APPROACHES TO THE BUDGET FUNDING DISTRIBUTION FOR THE REGIONAL RENEWABLE ENERGY DEVELOPMENT (SOTNYK I.)</b>	<b>84</b>
<b>CIRCULAR WATER MANAGEMENT SOLUTIONS FOR OPTIMISING IRRIGATED AGRICULTURAL PRODUCTION IN GHANA: THE RELEVANCE OF NANO TECHNOLOGY (EMMANUEL K. BOON, THOROLF KONRAD FRANZ GROSS, RICHARD OPPONG-BOATENG)</b>	<b>86</b>
<b>WASTEWATER TREATMENT COALITION PROJECTS: NEGOTIATING SUBSIDIES BY GROUPS OF POLLUTERS (ŠAUER P., BOROVIČKA A., KOLÍNSKÝ O., DVOŘÁK A.)</b>	<b>87</b>
<b>TRANSFORMATION OF COUNTRY'S INDUSTRIAL POLICY IN THE 20'S. XXI CENTURY (DYACHENKO A., KARINTSEVA O., TARASENKO S.)</b>	<b>88</b>
<b>RELATIONSHIP "INNOVATIONS-BRANDS OF COMPANIES-SUSTAINABLE DEVELOPMENT OF TERRITORY" (TARASENKO S., DURANOWSKI W.)</b>	<b>90</b>

<b>CURRENT TRENDS IN INNOVATIVE BUSINESS / ENTREPRENEURSHIP (MASLEY M., OVDIUK O.)</b>	<b>91</b>
<b>ECONOMIC SECURITY OF THE AGRARIAN SECTOR IN THE CONTEXT OF THE GLOBAL SUSTAINABLE DEVELOPMENT GOALS (UTENKOVA K.)</b>	<b>93</b>
<b>INTERNAL MECHANISMS FOR ENSURING THE CAPITAL ADEQUACY OF BANK (LOR A.)</b>	<b>95</b>
<b>ON THE WAY TO EUROPEAN INTEGRATION: APPLICATION OF THE FINANCIAL STATEMENTS TAXONOMY IN UKRAINE (VASYLISHYN S.)</b>	<b>97</b>
<b>GROWTH (YAROSHYNA A.)</b>	<b>99</b>
<b>ENTERPRISE RESOURCES: CURRENT TRENDS (CHICHULINA K.)</b>	<b>101</b>
<b>TRANSFORMATION OF EU AND UKRAINE ENERGY MARKETS IN CONVERGENCE CONDITIONS (YUKHYMETS R., SEMENIUK A.)</b>	<b>103</b>
<b>CENTRALIZED PUBLIC PROCUREMENT: INTEGRATING EU EXPERIENCE IN UKRAINE (YEVDOKYMOV A., SRIBRANETS Y.)</b>	<b>105</b>
<b>CHARACTERISTICS OF CROSS-CULTURAL FOUNDATIONS AS AN INTERACTIVE FACTOR OF BUSINESS DEVELOPMENT (PETRUSHENKO Y., KIRILIEVA A.)</b>	<b>107</b>
<b>UKRAINE ON THE INTERNATIONAL FREELANCE MARKET (PETRUSHENKO Y., ISHCENKO Y.)</b>	<b>109</b>
<b>SOLVING PRODUCTION PROBLEMS IN EUROPE BY INTRODUCING INTERNET OF THINGS TECHNOLOGIES (ZAKHARKIN O., OKHRIMCHUK Y.)</b>	<b>112</b>
<b>CORPORATE FINANCE TRANSPARENCY IN THE VALUE-ORIENTED BUSINESS MANAGEMENT SYSTEM (ZAKHARKINA L. NOVIKOV S., CHUKHNO R.)</b>	<b>114</b>
<b>DIGITAL TECHNOLOGIES IN INTERNATIONAL BUSINESS MANAGEMENT FROM THE PERSPECTIVE OF DEMAND (ZHANG KUAN)</b>	<b>116</b>
<b>EU FINANCIAL POLICY AND SOCIAL HOUSING IN THE CONTEXT OF ECONOMIC GROWTH AND SUSTAINABLE DEVELOPMENT (ZHUCHENKO S.)</b>	<b>117</b>
<b>ANALYSIS OF THE RELATIONSHIP BETWEEN ENERGY CONSUMPTION AND ECONOMIC GROWTH IN CHINA (ZIHUI JI)</b>	<b>120</b>

<b>FREE TRADE BY AGRI-FOOD PRODUCTS BETWEEN UKRAINE AND THE EU: PREFERENCES, BARRIERS, PROSPECTS (ZINCHUK T., KOVALCHUK O.)</b>	<b>122</b>
<b>EVALUATION OF THE EFFECTIVENESS OF LOGISTICS SOLUTIONS (KORDAS A., CHORTOK Y.)</b>	<b>124</b>
<b>SOFTWARE PRODUCT FOR LOGISTICS DELIVERIES (STEPANENKO Y., GONCHARENKO O.)</b>	<b>126</b>
<b>BLOGGER IS A MODERN PROFESSION (BILAN A., KUBATKO O.)</b>	<b>127</b>
<b>OPENING YOUR OWN HAIRDRESSING SALON AS A BUSINESS</b>	<b>129</b>
<b>ADVANTAGES AND DRAWBACKS OF SALES PROMOTION OF GOODS (ANCIBOR T., KUBATKO O.)</b>	<b>131</b>

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## **UNITED ENERGY SYSTEM OF UKRAINE: TOWARDS INTEGRATION INTO ENTSO-E**

One of the strategic aims of the government policy regarding the energy sector is the integration of the United Energy System of Ukraine (UESU) into the European Network of Transmission System Operators for Electricity (ENTSO-E). The joint work of the UESU and all-European energy system will increase the competition in the domestic energy market, create conditions for reducing electricity price, expand the opportunities for electricity exchange between neighbouring countries, etc. [1].

The UESU is a number of power plants operating on conventional and renewable energy resources, main and distribution networks, united by a common regime of production, transmission, and distribution of electricity. The UESU provides centralized electricity supply to domestic consumers, interacts with the energy systems of neighbouring countries, export and import of electricity.

The key parameter for the stable operation of the UESU is ensuring the balance between electricity generation and consumption. Balancing the energy system requires generating capacities, which can operate in different modes of operation: the basic mode, working with constant set capacity, and the maneuvering one, being able to change the amount of electricity generation. The peculiarity of the UESU is the excess of basic nuclear generation and the deficit of maneuvering capacities that creates significant challenges for its balancing. In recent years, the situation is complicated by intensive putting into operation solar and wind power plants, electricity generation based on which is difficult to predict and unstable, as it depends on climatic conditions, seasons, time of day, etc. One of the ways to solve the problems of balancing the UESU under the conditions of intensive development of green energy is the UESU integration into ENTSO-E.

ENTSO-E is a network of European electricity transmission system operators, which was established in 2009. As of 2021, ENTSO-E network unites 43 operators from 36 European countries [2]. The main objectives of ENTSO-E are to ensure the reliable operation, optimal management and development of the European electricity transmission system to ensure energy security and meet the needs of the internal energy market. In addition, as part of ENTSO-E, the members of energy systems perform power system security analysis, develop IT software standards, plan electrical network development, monitor compliance with European Union legislation, and implement innovative projects.

In June 2017, NEC “Ukrenergo” and ENTSO-E representatives concluded an agreement on the future integration of the UESU with the energy system of continental Europe. The cost of the project activities is 11.4 billion UAH, of which 4327 million UAH will be funded by the International Monetary Fund. The cost items of this project include the following components: power transmission network (4114 million UAH), formation of communication channels for the UESU technological management (2965 million UAH), performance of static and dynamic stability research (157 million UAH), “island” operation mode of the UESU (11.7 million UAH), compliance with the requirements of the Operational Handbook ENTSO-E (75.8 million UAH), measures to prepare the generation for joint work with ENTSO-E (4048 million UAH), as well as the certification of NEC “Ukrenergo” as the transmission system operator according to the Independent System Operator model (5 million UAH) [3].

The integration of the UESU into ENTSO-E has a number of advantages, the major of which are the following:

- demonopolization of the electricity sector;
- formation of transparent, stable, and reasonable electricity prices;
- modernization of old energy infrastructure, which includes decommissioning of obsolete units of coal and nuclear power plants;
- decarbonization of electricity sector, which will help to keep the global temperature at 1.5-2°C;
- ensuring the energy security by strengthening the reliability of the UESU operation, the possibility to receive emergency assistance from the energy systems of ENTSO-E countries, etc.

Thus, the synchronization of the UESU with ENTSO is an important step towards ensuring stable and reliable operation of the Ukrainian energy system, increasing its environmental friendliness and the ability to adapt to large-scale integration of renewable energy capacities.

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