Comprehensive Evaluation Method and Case Study on the Promotion and Application Effectiveness of Shore Power Supply Systems

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Abstract: The use of shore power supply system for ships at ports is one of the key promotion technologies for ship emission control according China’s 13th Five-Year Plan. However, there currently lacks established evaluation methods both in China and abroad for the assessment of shore power effectiveness. This study focuses on the most prevalent issues faced by various local regions in their promotion and application of shore power, proposes a set of evaluation methods tailored for local governments in the evaluation of promotion and application from five perspectives: construction and utilization of shore power facilities, institutional mechanisms, incentive policies and regulatory framework as well as a comprehensive evaluation of shore power effectiveness in Shenzhen as a case study. Results demonstrate that the evaluation method can fully reflect the effectiveness of local governments in their promotion of shore power, identify existing issues and opportunities for improvement, and may provide a baseline for the next-phase promotion of regional shore power facilities.

1. Introduction
Use of shore power for ships at ports is an effective technology for ship emission control[1]. It is also one of the key promotion technologies according to China’s 13th Five-Year Plan. Law of the People’s Republic of China on the Prevention and Control of Atmospheric Pollution implemented in 2016 as well as a series of documents issued by the Central Committee of the Communist Party of China and the State Council in 2018 on tackling pollution prevention and control including Opinions of the Central Committee of the Communist Party of China and the State Council on Strengthening the Protection of the Ecological Environment in All Aspects and Firmly Winning the Battle of Preventing and Controlling Environmental Pollution, the Circular of the State Council on Issuing the Three-year Action Plan for Winning the Battle for a Blue Sky and the Action Plan for Winning the Battle of Controlling Diesel Truck Pollution have all proposed outlined requirements for using shore power in ports. However, due to various limitations including relative high costs associated with shore power facility construction, undesirable implementation of preferential policies for electricity, and lack of standardization in operations and maintenance, shore power facilities faces issues such as low utilization rate and unsatisfactory effectiveness in promotion and application[2]. At present, there lacks established evaluation methods in China and abroad for the assessment of the promotion and application effectiveness of shore power; Therefore, an objective assessment of the promotion and application of shore power facilities at local levels remains difficult, so does a full reflection of existing issues and weak links in local governments’ promotion processes. This study focuses on the
outstanding issues faced by various regions in their promotion and application of shore power, and offers a set of comprehensive evaluation indexes for a scientific evaluation of the effectiveness of promotion and application of shore power by local governments, identify challenges and opportunities, propose recommendations for the further promotion of shore power facilities, and continue to enhance their effectiveness.

2. Evaluation Method
Using shore power for ships in ports can effectively reduce pollution emission during vessel docking, thence producing significant social and environmental benefits; However, due to high cost of investment and insignificant economic returns, solely market-driven promotion of shore power is difficult to achieve in its current phase. Therefore, scientific top-level design from local governments is required, alongside well-defined construction goals for shore power facilities, resolution of existing issues regarding institutional mechanisms during the course of promotion and implementation, incentive policies and funding support, and simultaneous improvement of regulations and standards. This study proposes a set of evaluation methods tailored to local governments in their assessment of the effectiveness of promotion and application from five perspectives: construction and utilization of shore power facilities, institutional mechanisms, incentive policies and regulatory systems.

2.1 Evaluation Index System

2.1.1 Shore Power Facility Construction. The Plan for the Layout and Construction of Shore Power at Ports was issued by the Ministry of Transport in July 2017[3], which explicitly set forth the goal of retrofitting all shore power facilities at major ports along domestic coasts and inland rivers, as well as ports within vessel emission control areas by the year 2020, while requiring local competent transportation authorities to compile implementation plans to carry forward the retrofitting of shore power facilities in an orderly manner and ensure timely completion. This study sets forth two evaluation indexes related to the construction of shore power facilities, namely: 1) whether shore power construction plans for ports have been formulated; and 2) whether shore power construction for ports is in conformity to requirements set forth in the Plan for the Layout and Construction of Shore Power at Ports.

2.1.2 Shore Power Usage. Usage rates pertaining to shore power facilities is the deciding factor in the actual reduction of emissions and serves as the most direct and effective evaluation index - with higher use rate and power consumption comes higher reduction of emissions. The State of California in the U.S. has currently introduced compulsory provisions for shore power usage for docked vessels, while certain EU countries including the Netherlands have continued to advocate shore power usage for ships at ports[4]. This study sets forth two indexes to evaluate the usage conditions of shore power facilities, namely: 1) Shore Power Usage Ratio for Ships at Ports; and 2) Annual Shore Power Consumption per Ship at Ports (ten thousand kilowatt hours).

2.1.3 Institutional Mechanism Building. Shore power is currently in a stage of popularization in China and is generally lacking in sound institutional mechanisms all around. This requires relevant departments to engage in planning and coordination to promptly break through the institutional mechanism barriers that inhibit the promotion of shore power. On a national level, the Ministry of Transportation, Ministry of Finance, the National Development and Reform Bureau, and the National Energy Administration have alongside the State Grid Corporation and the Southern Power Grid Company, collectively issued the Notice on Further Joint Promotion of the Use of Shore Power by Ships at Ports in February 2019, which establishes a collaborative promotion system for shore power for port ships on a basic level[5]. Local governments still need to implement national stipulations on shore power promotion, introduce local policies, strengthen publicity efforts, and actively promote the usage of shore power. This study sets forth five indexes to evaluate the utilization of shore power
facilities: 1) whether specialized institutions have been set up for shore power promotion; 2) whether relevant promotional policy documents have been issued; 3) whether pricing policies have been implemented in practice by shore power operating businesses for docked vessels; 4) whether methods for collecting shore-power-related service charges have been developed; and 5) whether relevant publicity programs have been developed regarding the usage of shore power by docked vessels[6].

2.1.4 Incentive Policies for Shore Power. Shore power allows for reduced emission of pollutants during docking for vessels. However, due to relatively high investment costs and insignificant economic returns, a certain degree of policy and financial support is required during its promotional stage. At the national level, relevant authorities including the Ministry of Transportation, the Ministry of Finance and the National Development and Reform Bureau have formulated policies on financial incentives for the construction of ports and shore power facilities[7]. At local levels, governments need to introduce additional supporting incentive policies to strengthen support for shore power promotion. This study sets forth five indexes to evaluate the utilization of shore power facilities: 1) Financial Subsidy Policies for Shore Power Construction; 2) Subsidy Policies for Trial/Test Operations; 3) Implementation Status of Demand Charge Reduction Policies for Shore Power Usage; 4) Preferential Policies for Shore Power Electricity Charges; 5) Subsidy Policies for Shore Power Facility Management and Maintenance; 6) Preferential Policies for Shore Power Energy Consumption Assessments; and 7) Commitment to Priority Berthing/Lockage Rights for Shore Power Vessels.

2.1.5 Regulatory System. A scientific and effective regulatory system serves as an important prerequisite for standardized use of shore power facilities, elimination of accident potential, and overall boost to shore power adoption. In order to promote standardization for the construction and utilization of shore power, the Ministry of Transportation is currently drafting the Administrative Measures for the Use of Shore Power by Ships at Port of Call, which will be published before the end of the year. This study sets forth two indexes to evaluate the utilization of shore power facilities: 1) whether systems for regular report submission and assessment regarding shore power construction and usage have been established; and 2) whether safety inspection systems for shore power facilities have been established.

2.2 Scoring Standards and Index Weight

This study investigates the construction and utilization of shore power facilities located in major ports in China and determines standard scoring values for indexes including shore power usage ratios for docked vessels and annual power consumption for individual berths based on gathered feedback. Meanwhile, scoring standards and values for the remaining indexes are determined via scoring by an expert panel. See Table 1 for details.

3. Case Study

The Shenzhen Municipal Government has provided vigorous support for the Port of Shenzhen’s shore power supply project, and has introduced various favorable policies aimed at conserving power-related expenditures for port and shipping businesses, as well as enhancing the effectiveness of application of shore power. With Shenzhen as an example, this study shall evaluate the effectiveness of the local government’s application of shore power at its port.

3.1 Shore Power Facility Construction

By February 2019, 25 large deep-water berths in the Port of Shenzhen, as well as its four major container terminals and the Prince Edward Cruise Home Port have the capacity to provide shore power services. Fully constructed and in-service shore power locations include: Yantian International Port (6 sets of shore power units covering 13 berths), Shekou Container Terminal (2 sets covering 3 berths), Chiwan Container Terminal (1 set covering 4 berths), Da Chan Bay Terminal (2 sets covering 2 berths), Mawan Electric Power Plant (2 sets covering 2 berths), and Prince Edward Cruise Home Port (1 set
covering 1 berth).

In 2017, the municipal government of Shenzhen issued the Notice from the Municipal Transportation Commission on the Printing and Distribution of the Shore Power Promotional Layout Plan for the Port of Shenzhen, further assigned responsible bodies for the construction of shore power facilities at the port, and planned to achieve an 80% shore power coverage rate for its container, passenger and cruise terminals by the year 2020. Based on the Port Shore Power Layout Scheme, the Port of Shenzhen is required to completely retrofit all shore power facilities at its 28 established berths, including 26 container berths, 1 ro-ro passenger berth, and 1 cruise berth, before the end of 2020. Based on existing figures, by the end of June 2019, the Port of Shenzhen has completed retrofitting of shore power facilities at 25 specialized container berths and 1 cruise berth, or 93% of its retrofitting objective as designated by the Port Shore Power Layout Scheme. Based on the above, the Construction section of Shenzhen’s shore power facilities is entitled to a full score of 10 points.

Table 1. Index System and Scoring Methods for the Evaluation of Application Effectiveness of Shore Power by Local Governments

| Criterion | Index | Description of Index | Scoring Standards | Score Value |
|-----------|-------|----------------------|-------------------|-------------|
| Plan Formulation | Plan Formulation | | Whether shore power construction plans for local ports have been formulated; whether retrofitting goals for shore power facilities have been established. | Allocate 4 points for regions that have formulated and released plans for shore power construction at ports. | 4 |
| Construction (10 Points) | Conformity with Plan for the Layout and Construction of Shore Power at Ports | | Whether shore power constructions for ports have conformed to requirements set forth in the Plan for the Layout and Construction of Shore Power at Ports. | Allocate 6 points for regions that have formulated local construction plans and whose year 2020 goals conform to Plan for the Layout and Construction of Shore Power at Ports requirements. Allocate 6 points for ports not included in the Plan. 1. Allocate 15 points for coastal regions with a ratio of ≥10% or inland regions with ≥20%. 2. Deduct points proportionately for ratios less than those indicated above. | 6 |
| Usage (30 Points) | Shore Power Usage Ratio for Ships in Ports (%) | | Ratio of port-docked ships that use shore power to all docked vessels (with the exclusion of public vessels and port crafts) per year. | 1. Coastal regions with ≥800 thousandkwh/year, or inland regions with ≥300 thousand kwh/year. 2. Deduct points proportionately for ratios less than those indicated above. | 15 |
| Annual Shore Power Consumption per Ship at Port | | Yearly power consumption of shore power for each berth. | 1. Coastal regions with ≥800 thousandkwh/year, or inland regions with ≥300 thousand kwh/year. 2. Deduct points proportionately for ratios less than those indicated above. | 15 |
| Institutional Mechanisms (15 Points) | Specialized Promotional Institutions | | Whether specialized institutions have been set up within local government departments that are tasked with promoting usage of shore power technology for | 1. Allocate 1.5 points for regional government departments that have appointed specialized institutions responsible for the promotion of shore power | 3 |
| Category                                    | Details                                                                                                                                                                                                 | Points |
|--------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| Promotional Policy Documents               | Whether specialized work plans or policy documents have been issued in regard to promotional work related to shore power usage for port-docked vessels. 1. Allocate 3 points if specialized work plans for shore power promotion have been issued within the last 3 years. 2. Allocate 2 points if sections or chapters within other issued policy documents have been dedicated to shore power promotion. | 3      |
| Pricing Policy Implementation             | Whether local government departments including Development and Reform, Energy, and Transportation have implemented policies that grant shore power operating businesses at ports adequate rights to collect electricity fares from docked vessels based on current electricity pricing policies. Allocate 4 points if the region has issued policies that enable electricity fare collection from docked vessels for shore power operating businesses. | 4      |
| Methods for Collecting Service Charges     | Whether the local government has formulated policies related to shore-power-related service charges. 1. Allocate 3 points if the region has formulated charging standards for shore power service fees. | 3      |
| Publicity Programs                         | Whether the local government has developed any publicity programs that aim to inform on relevant standards and specifications including provisions contained in the *Law on the Prevention and Control of Atmospheric Pollution*, national- and regional-level shore power incentive policies, and regional shore power facility construction goals. Allocate 2 points if any such publicity programs have been established. | 2      |
| Incentive Policies (35 Points)             | Financial Subsidies for Construction                                                                                                                                                                  |        |
|                                            | Whether relevant policies have been enacted regarding the subsidization of shore power facility construction costs at ports. Allocate 6 points if local subsidy policies for shore power facility construction at ports have been enacted. |        |
| Subsidies for Trial/Test Operations | Whether relevant policies have been enacted regarding the subsidization of shore power facility vessel connection testing and trial phase operations costs at ports. | Allocate 5 points if local subsidy policies for shore power facility vessel connection testing and trial operations at ports have been enacted. | 5 |
| Implementation of Electricity Demand Charge Reduction Policies | Whether reduction to demand charges within the two-part electricity pricing system related to shore power usage for docked vessels has been fully implemented in accordance with state requirements. | Allocate 5 points if demand charge reduction has been implemented for shore power usage by docked vessels. | 5 |
| Preferential Policies for Electricity Charges | Whether preferential policies are in place (e.g. adopting large industry electricity rates, providing subsidies, etc.) regarding electricity prices for usage of shore power by docked vessels. | Allocate 5 points if preferential policies for electricity pricing for shore power usage by docked vessels are in place. | 5 |
| Subsidies for Facility Management and Maintenance | Whether policies are in place regarding the subsidization of shore power facility operations and maintenance costs at ports. | Allocate 4 points if subsidization policies for shore power facility operations and maintenance are in place. | 4 |
| Preferential Policies for Relevant Assessments (e.g. Energy Consumption Assessment) | Whether usage of shore power by docked vessels is subject to preferential consideration during enterprise energy consumption and greenhouse gas emissions assessments. | Allocate 4 points if preferential consideration is afforded for shore power usage during enterprise energy consumption and greenhouse gas emission assessments, or if said assessments are not applicable. | 4 |
| Priority Berthing/Lockage | Whether incentives have been created for the usage of shore power by docked vessels, and whether rights including priority lockage, reduction to lockage fees and priority berthing and unberthing have been granted for vessels using shore power. | Allocate 2 points for each preferential policy in effect, including priority lockage, reduction to lockage fees and priority berthing and unberthing, up to a maximum of 6. | 6 |
| Periodic Report Submission and Assessment Framework on Construction and Usage | Whether periodic report submission frameworks have been established for the construction and usage of port enterprise-operated shore power facilities within jurisdictions, and whether assessment | 1. Allocate 2 points if periodic report submission frameworks have been established for the construction and usage of port enterprise-operated shore power facilities. 2. Allocate 3 points if assessment methods have been formulated, and periodic assessment has been implemented. | 5 |
Methods and periodic assessments have been formulated and conducted regarding the usage of port enterprise–operated shore power facilities. Whether safety inspection systems have been established for the construction of port enterprise–operated shore power facilities within jurisdictions, and whether dedicated periodic or spot inspections are carried out in regard to shore power facilities.

1. Allocate 2 points if safety inspection systems have been established for shore power facilities operated by enterprises at ports.
2. Allocate 3 points if specialized inspection systems have been established for shore power facilities operated by enterprises at ports.

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3.2 Shore Power Facility Usage

The utilization of shore power for docked ships in Shenzhen has been on an upward trajectory over the past few years. The number of ships using shore power was 21 in 2016 and increased to 46 in 2017 and 180 in 2018. Usage figures for shore power for major shipping enterprises in 2018 are listed in Table 2. According to the table, the utilization of shore power at the Port of Shenzhen is approximately 3.6%, lending to a score of 10.8 points in regard to Usage Ratio for shore power facilities. As most facilities at the Port of Shenzhen classify as high-voltage and high-capacity, the overall power consumption is magnificent. Statistics also show that the annual electricity consumption for shore power of docked vessels at the Port of Shenzhen in 2018 exceeded 6 million kWh, equating to a full score of 15 points in regard to its Annual Electricity Consumption.

Table 2. Shore Power Usage in the Port of Shenzhen by Major Shipping Enterprises in 2018

| Shipping Enterprises | Total Vessels Docked | Shore Power Usage Frequency | Usage Ratio |
|----------------------|----------------------|-----------------------------|-------------|
| COSCO                | 695                  | 55                          | 7.9%        |
| CMA CGM              | 609                  | 30                          | 4.9%        |
| OOCL                 | 698                  | 19                          | 2.7%        |
| YANGMING             | 482                  | 1                           | 0.2%        |
| MAERSK               | 362                  | 19                          | 5.2%        |
| MCC                  | 773                  | 30                          | 3.9%        |
| ONE                  | 363                  | 1                           | 0.3%        |
| EVER GREEN           | 1016                 | 2                           | 0.2%        |
| CINASHIP             | 38                   | 23                          | 61.0%       |
| Total                | 5036                 | 180                         | 3.6%        |

3.3 Institutional Mechanism Building

Under the leadership of the municipal government of Shenzhen, the Shenzhen Bureau of Transportation (Bureau of Port Administration) is commissioned with the construction and management of shore power facilities. However, at present the city of Shenzhen has not established any interdepartmental meeting or consultation mechanisms, nor formulated multidivisional working mechanisms for the promotion of shore power[8].

The Five-Year Action Plan for Green and Low-Carbon Port Construction in Shenzhen (2016-2020) was issued by the municipal government of Shenzhen in 2016, which stated the explicit proposal to “fully implement construction of shore power facilities in the Port of Shenzhen and continue to expand the coverage of berths supplying shore power. By the end of 2016, shore power facility construction at
the Prince Edward Cruise Home Port shall be completed, shore power supply facilities shall be outfitted at the 4 major container terminals, 15 berths with shore power access shall be provided at major port areas, and newly constructed, specialized container, bulk cargo, ro-ro passenger, and cruise berths shall be equipped with the capacity to supply shore power to docked vessels with the aim to achieve a shore power utilization for docked container ships of no less than 15% before the end of 2019”. In 2018, the Shenzhen municipal government issued the Notice from the Municipal Transportation Commission on the Printing and Distribution of the Shore Power Promotional Layout Plan for the Port of Shenzhen, further assigned responsible bodies for the construction of shore power facilities at the port and planned to achieve an 80% shore power coverage rate for its container, passenger and cruise terminals by the year 2020. Hence the Institutional Mechanisms section of Shenzhen’s shore power facilities is entitled to a full score of 15 points.

3.4 Shore Power Incentive Policies

The Shenzhen municipal government issued the Interim Measures for the Management of Subsidies for Port Shore Power Facilities and Marine Low-Sulfur Fuel in Shenzhen in 2014, and made revisions to said measures in 2017, re-issuing the Interim Measures for the Management of Subsidies for Green and Low-Carbon Port Construction in Shenzhen. The new measures administer subsidies for Shenzhen’s port shore power facility construction, retrofitting of power-receiving facilities, and shore power usage. These subsidies are mainly targeted at port shore power facility construction costs, power-receiving facility retrofit costs, power supply demand charge costs, shore power testing costs for first-time docking, shore power electricity costs, shore power facility maintenance costs and shore power usage costs. In December 2018, the Shenzhen Development and Reform Commission re-issued the Notice on Issues Related to Electricity Price for Shore Power at Ports, formulated by the Guangdong Provincial Development and Reform Commission, thence clarifying that large industry electricity rates are to be adopted as standard for port shore power operators operating facilities at 315 kVA or above, and that operators at ports implementing the two-part electricity price system are to be exempt from demand (capacity) charges[9].

Among incentive measures currently issued by the Shenzhen government, no preferential policies exist regarding energy consumption and greenhouse gas emissions assessments for enterprises in the context of shore power use by docked vessels, nor are any incentive measures yet in place to encourage use of shore power by docked vessels, priority lockage, reduction to lockage fees, and priority berthing and unberthing. After corresponding deductions, Shenzhen is entitled to a score of 25 points in regard to the Incentive Policies section.

3.5 Regulatory System Building

At present, the Shenzhen municipal government has not established periodic report submission frameworks for the construction and usage of port enterprise-operated shore power facilities, nor have assessment methods been formulated regarding the usage of port enterprise-operated shore power facilities. The Shenzhen Maritime Bureau is tasked with conducting periodic special inspections on the safety status of port shore power facilities based on regulatory requirements. Therefore, Shenzhen is entitled to a score of 5 points in regard to its Regulatory System.

Table 3. Evaluation Results on the Effectiveness of Promotion and Application of Shore Power

| Criterion | Index | Max. Score | Score (Shenzhen) |
|-----------|-------|------------|-----------------|
| Construction | Plan Formulation | 4 | 4 |
| | Conformity with Plan for the Layout and Construction of Shore Power at Ports | 6 | 6 |
| Usage | Shore Power Usage Ratio for Ships at Ports(%) | 15 | 10.8 |
| | Annual Shore Power Consumption per Ship at Ports | 15 | 15 |
Institutional Mechanisms

| Specialized Promotional Institutions | 3 |
|--------------------------------------|---|
| Promotional Policy Documents         | 3 |
| Pricing Policy Implementation       | 4 |
| Methods for Collecting Service Charges | 3 |
| Publicity Programs                   | 2 |
| Financial Subsidies for Construction | 6 |
| Subsidies for Trial/Test Operations  | 5 |

Incentive Policies

| Implementation of Electricity Fee Reduction Policies | 5 |
| Preferential Policies for Electricity Charges       | 5 |
| Subsidies for Facility Management and Maintenance   | 4 |
| Preferential Policies for Relevant Assessments (e.g. Energy Consumption Assessment) | 4 |
| Priority Berthing/Lockage                          | 6 |

Regulatory System

| Periodic Report Submission and Assessment Framework on Construction and Usage | 5 |
| Safety Inspection Systems                                                    | 5 |

Total 100 80.8

4. Conclusion and Proposals

4.1 This study has, on the basis of current general circumstances surrounding the development of shore power and focusing on prevalent issues concerning the process of promotion and application of shore power in various regions, established a set of evaluation methods for the effectiveness of promotion and application of shore power by local regional governments based on five aspects related to shore power facilities: their construction, usage, institutional mechanisms, incentive policies, and regulatory systems. Case study results demonstrate that this method can fully reflect achievements made by local governments in promoting shore power, uncover existing issues and weak links, and provide a basis for the next-phase promotion of regional shore power facilities.

4.2 Alongside further progression of work related to the promotion of shore power usage by docked vessels, said promotion efforts may be met with new demands and complications, which in turn may necessitate adjustments to evaluation indexes and weights based on new complications and circumstances to better adapt to the needs of shore power promotion in new contexts.

4.3 The city of Shenzhen has conducted a wide range of work related to shore power promotion and application; it has made rapid progress in facility construction, achieved a comparatively sound institutional mechanism for promotion, issued incentive policies directed towards promotion efforts, subsidizes promotion to a relatively substantial degree, and displays a generally robust degree of effectiveness in its application of shore power. However, Shenzhen's usage rate of shore power facilities is low overall, and has yet to enact preferential policies for shore power usage in the context of energy consumption assessments for enterprises, incentive measures including priority berthing and lockage for vessels using shore power, or methods of assessment for port enterprise shore power facilities; such are all factors warranting reinforcement during the successive phases of work.
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References:
[1] Dai L., Hu H., Wang Z.J., Shi Y.F., Ding S.W. (2019) An environmental and techno-economic analysis of shore side electricity. Transportation Research Part D: Transport and Environment. 75:223-235.
[2] Parth V., Paul S. F, Granger M., James J. C. (2016) View Author Information Shore Power for Vessels Calling at U.S. Ports: Benefits and Costs. Environ. Sci. Technol. 50, 3:1102-1110.
[3] The Plan for the Layout and Construction of Shore Power at Ports. http://xxgk.mot.gov.cn/jigou/syj/201707/t20170728_2977792.html
[4] Policy made by MOT, MOF, NDRC, NEA, State Grid and Southern Power Grid. http://xxgk.mot.gov.cn/jigou/syj/201902/t20190220_3167489.html
[5] Notice on further jointly promoting the use of shore power.(2019) Thalis P.V.Z. (2019) Prospects of cold ironing as an emissions reduction option. Transportation Research Part A: Policy and Practice. 119:82-95.
[6] He J.X., Li X., Xu H.S., Zhu J.D., Dai P. Chu H.L. (2017) Review and Discussion on Standards for Shore-to-Ship Power Supply System. In: Proceedings of the 4th Annual International Conference on Material Engineering and Application. Wuhan, 22-26.
[7] Feng Y., Li H.B. (2017) Study of safety and economy of utilizing shore power supply system for oceangoing ship. In: 2017 4th International Conference on Transportation Information and Safety. Banff, AB, 409-414.
[8] Peng C.S. (2015) Discussion on promoting the use of shore power for offshore ships. Port Economy, 9:17-22.
[9] Li H.B. (2019) Analysis for Shore Power Economy in Preventing Air Pollution of Vessels are Docked at the Berth. E3S Web of Conferences. 118:1-5.