Development of Circular Economy in China
## Contents

1 Origin and Background of Circular Economy Development .......................... 1  
   1.1 China's National Conditions .................................................. 2  
      1.1.1 China's Population and Demographic Distribution ............. 3  
      1.1.2 A Vulnerable Foundation for Development ....................... 10  
   1.2 Staged Characteristics of China's Economic Development  
      Since the Reform and Opening-up Initiative, as Well as  
      Its Impacts on Resources and the Environment ....................... 10  
      1.2.1 The Background of Economic Development  
            at the Initial Stage of Reform and Opening-up ............ 10  
      1.2.2 Characteristics of China's Economic Development  
            in 1980-1995 and Its Impacts on the Environment ........... 11  
      1.2.3 Main Features of China's Economic Development  
            from 1996 to 2010 and Its Environmental  
            and Resource Impact ........................................... 14  
   1.3 From Environmental Protection to Circular Economy ...................... 17  

2 The Role of Government and China's Policy System  
for Circular Economy ............................................................ 21  
   2.1 Why Did the Chinese Government Facilitate  
       the Circular Economy Development ................................... 21  
      2.1.1 Free Market Economy in Britain: The First Generation  
            of Industrialization Featured by the Difficulty  
            in Resource Recycling ........................................... 21  
      2.1.2 Free Market Economy in the United States:  
            The Second Generation of Industrialization  
            in Which the Government Played a Role ......................... 22  
      2.1.3 Capitalist Market Economy in Japan: The Third  
            Generation of Industrialization Under the Leadership  
            of the Government .............................................. 23
2.1.4 Socialist Market Economy in China: The Fourth Generation of Industrialization Dominated by the Government ........................................... 25

2.2 How Has China Promoted the Circular Economy ........................................... 28

2.3 Legal and Regulatory Policy System for Circular Economy Development in China ........................................... 34

2.3.1 History of China’s Legal and Regulatory Policies on the Circular Economy ........................................... 34

2.3.2 Characteristics of China’s Legal and Regulatory Policies on Circular Economy ........................................... 45

2.4 Development Strategy and Immediate Action Plan of Circular Economy During the 12th Five-Year-Plan Period ........................................... 48

2.4.1 To Focus on the 10 Circular Economy Demonstration Projects ........................................... 48

2.4.2 To Cultivate 100 Circular Economy Demonstration Cities (Counties) ........................................... 51

2.4.3 To Cultivate 1000 Circular Economy Demonstration Enterprises (Industrial Parks) ........................................... 52

References ........................................................................................................ 52

3 The Fundamental Modes and Achievements of China’s Circular Economy Development ........................................... 55

3.1 Fundamental Modes of China’s Circular Economy Development ........................................... 56

3.1.1 The Top-Down Dynamic Model and Addressing the Crux ........................................... 56

3.1.2 To Enable “the Visible Hand” to Cooperate with “the Invisible Hand” ........................................... 58

3.2 To Build a Model for the Circular Economy-Oriented Practice with Chinese Characteristics ........................................... 60

3.2.1 To Set up the Mechanisms of Leadership and Coordination at Different Levels ........................................... 60

3.2.2 To Provide Institutional Guarantee at Different Levels ........................................... 61

3.2.3 Fiscal Means to Directly Carry Out Circular Economy Pilot Projects ........................................... 62

3.3 To Set up a Microscopic Circular Economy Model with Chinese Characteristics ........................................... 66

3.3.1 Microscopic Models of the Circular Economy in Key Industries ........................................... 66

3.3.2 The Composite and Cross-Industry Circular Economy-Oriented Models in Agriculture ........................................... 70

3.3.3 Circular Economy-Oriented Models for Industrial Parks ........................................... 71

3.3.4 Models of Remanufacturing and Resource Recycling ........................................... 74
3.4 Remarkable Achievements Harvested in the Decade ........................................... 75
  3.4.1 Census of the Whole Society and National Strategic Action .......................... 76
  3.4.2 Circular Economy and Technological Innovation ............................................. 76
  3.4.3 Wastes Recycling ......................................................................................... 77
  3.4.4 Recycling of Renewable Resources .................................................................. 79
  3.4.5 Efficiency and Benefits of Resource Utilization ............................................. 81

References .................................................................................................................. 83

4 China's Steel Industry Transformed by Circular Economy .................................. 85
  4.1 Amazing Size and Technological Structure ......................................................... 85
    4.1.1 The "Steel Dream" for the Rejuvenation of the Chinese Nation ...................... 85
    4.1.2 An Amazing Superpower in Steel Output ...................................................... 86
    4.1.3 A Museum Showcasing the Technologies Adopted by the Steel Industries from Across the World ............................................................. 87

  4.2 Circular Economy Transforming Steel Plants into "Power Plants" ...................... 89
    4.2.1 Importance of Energy Conservation in the Steel Industry ............................ 89
    4.2.2 Taking Advantage of Technological Innovations to Reduce Primary Energy Consumption ................................................................. 89
    4.2.3 Recovering Secondary Energy and Building Distributed Generation Assemblies ................................................................. 90

  4.3 Circular Economy Transforming Steel Plants into "Mineral Treasures" ............... 92
    4.3.1 With the Magic Phrase of "Open Sesame", Wastes Transforming into Resource Treasures ................................................................. 92
    4.3.2 Maximizing the Performance of Ferrous Resources ..................................... 92
    4.3.3 Steel Enterprises Transforming into "Building Material" Producers .............. 93
    4.3.4 Embarking on a Path Towards Diversified Utilization for Higher Value ........ 94

  4.4 Combination of Water Conservation and Utilization of Reclaimed Water ......... 95
    4.4.1 Giving Top Priority to Water Conservation ................................................. 95
    4.4.2 Steel Enterprises Transforming into "Reclaimed Water Plants" ..................... 97

References .................................................................................................................. 97

5 The Circular Economy-Oriented Practice in the Nonferrous Metal Industry ........ 99
  5.1 The Necessity to Develop Circular Economy in the Nonferrous Metal Industry ................................................................. 100
    5.1.1 Characteristics of the Production in the Nonferrous Metal Industry ............. 100
7 The Circular Economy-Oriented Practice in the Electric Power Industry ........................................ 143
  7.1 Development of China's Electric Power Industry ........................................ 143
    7.1.1 World's Largest Electricity Generator ........................................ 143
    7.1.2 Thermal Power-Centered Electric Power Structure ........................................ 144
    7.1.3 A Huge Interconnected Power Grid ........................................ 144
  7.2 Origin of the Circular Economy-Oriented Development in the Electric Power Industry ........................................ 145
  7.3 Legal and Regulatory Policies on Circular Economy Promotion ........................................ 146
  7.4 Circular Economy-Oriented Practice in the Electric Power Industry ........................................ 154
    7.4.1 Technological Path to Circular Economy-Oriented Development in the Electric Power Industry ........................................ 154
    7.4.2 Models of Circular Economy-Oriented Development ........................................ 159
  7.5 Achievements of Circular Economy-Oriented Development in the Electric Power Industry ........................................ 163
    7.5.1 Remarkable Reductions in Coal Consumption for Power Generation ........................................ 163
    7.5.2 Remarkable Reductions in Water Consumption for Power Generation ........................................ 163
    7.5.3 Sharp Reductions in Air Pollutant Emissions ........................................ 164
    7.5.4 Considerable Reductions in Waste Water Discharge ........................................ 166
    7.5.5 Increasing the Ratio of Comprehensive Utilization of Solid Wastes ........................................ 166
  7.6 Prospects of the Circular Economy Development in China's Electricity Power Industry ........................................ 167
Reference ........................................ 168

8 The Circular Economy-Oriented Practice in the Petrochemical Industry ........................................ 169
  8.1 Overview of the Industrial Development ........................................ 169
  8.2 Necessity to Develop the Circular Economy in the Industry ........................................ 170
  8.3 Achievements of Circular Economy-Oriented Development in the Industry ........................................ 172
  8.4 Major Policies and Measures for the Circular Economy Development in the Industry ........................................ 174
    8.4.1 Formulating Laws and Regulations and Implementing the Policies on Circular Economy Development ........................................ 174
    8.4.2 Reducing the Industrial Structure and the Product Mix and Increasing the Efficiency of Comprehensive Utilization of Resources ........................................ 175
8.4.3 Making Positive Efforts in Promoting and Applying Technological Innovations for Circular Economy Development ........................................... 175
8.4.4 Giving Play to the Industrial Parks and Facilitating the Pilot Demonstration of Circular Economy ..................................................... 176
8.5 Typical Models of Circular Economy Development in the Industry ............................................................................................... 177
8.6 Case Study on Circular Economy Development in the Industry ................................................................................................. 179
8.7 Prospects of Circular Economy Development in the Industry ........................................................ ........................................... 181

9 The Circular Economy-Oriented Practice in the Papermaking Industry .......................................................................................... 183
9.1 Overview of the Industrial Development ................................................................................................................................. 183
9.2 Necessity to Develop the Circular Economy in the Industry ........................................................................................................ 185
  9.2.1 Firstly, It Is Necessary to Develop the Circular Economy to Transform the Energy-Intensive Industry .................. 185
  9.2.2 Secondly, It Is Necessary to Develop the Circular Economy to Protect the Environment ................................................. 186
9.3 Major Policies and Measures for the Circular Economy Development in the Industry ............................................................. 188
  9.3.1 Promoting the Circular Economy Development with Policies and Regulations ................................................................. 188
  9.3.2 Strengthening the Guiding Role of Industrial Policies in Developing the Circular Economy ........................................... 189
  9.3.3 Taking Advantage of the Role of Intermediary Organizations in Facilitating Circular Economy Development ......................... 191
  9.3.4 Popularizing Advanced Equipment, Making Technological Innovations, and Promoting Circular Economy Development ........................................... 192
9.4 Achievements of Circular Economy Development in the Industry ................................................................................................. 192
9.5 Case Study on Circular Economy Development in the Industry ................................................................................................. 193
  9.5.1 Group Profile ........................................................................................................................................................................ 193
  9.5.2 Enterprise's Circular Economy-Oriented Practice ................................................................................................................. 194
  9.5.3 Enterprise's System of Circular Economy Development .................................................................................................... 197
  9.5.4 Enterprise's Achievements in Its Circular Economy Development ......................................................................................... 199
  9.5.5 Revelations from the Enterprise's Circular Economy Development ....................................................................................... 199
10 The Circular Economy-Oriented Practice in the Food Manufacturing Industry

10.1 Overview of the Industrial Development

10.1.1 Overview of the Development of the Food Industry

10.1.2 Overview of the Development of the Fermentation Industry

10.2 Necessity to Develop the Circular Economy in the Industry

10.3 Major Policies and Measures for Circular Economy Development in the Industry

10.3.1 To Guide Circular Economy Development in the Industry with Policies and Regulations

10.3.2 To Set Industrial Development Goals Through Defining Binding Standards for Cleaner Production and Discharge Reduction of Major Pollutants

10.3.3 To Carry Out Pilot Projects for Circular Economy Development and Bring the Demonstration Effect of Industrial Parks into Full Play

10.3.4 To Promote Technological Innovations, and Enhance Core Competitiveness

10.3.5 To Establish the Mechanism of Environmental Scrutiny, and Strengthen the Guidance for and Supervision on Enterprises

10.4 Achievements of Circular Economy Development in the Industry

10.5 Case Study on Circular Economy Development in the Industry

10.5.1 COFCO Biochemical (AnHui) Co., Ltd

10.5.2 Luzhou Bio-Chem Technology Ltd

10.6 Future Development of the Circular Economy in the Food Industry

10.6.1 To Improve the Policy and Law System and Increase the Operability of Policies

10.6.2 To Carry Out Industrial Restructuring

10.6.3 To Cement the Building of the Industrial Chain

10.6.4 To Further Improve Technological Capabilities Through Developing the Key Technologies

11 Circular Economy-Oriented Agricultural Practice

11.1 Driving Force for Agricultural Circular Economy Development

11.2 Definition and Features of China’s Agricultural Circular Economy

11.3 Operation of China’s Agricultural Circular Economy

11.4 China’s Policies and Measures to Promote the of Agricultural Circular Economy Development
## 11.5 Case Study on Agricultural Circular Economy Development

**11.5.1 The Model of Agricultural Wastes Recycling**  
228

**11.5.2 Internal Recycling Models of the Agricultural Production Sectors**  
231

**11.5.3 Models of the Composite Industrial and Agricultural Circular Economy**  
235

## 11.6 Technological Support System for Agricultural Circular Economy

**11.6.1 Technologies of Biomass Development and Comprehensive Utilization**  
241

**11.6.2 Technologies of Animal Wastes Recycling**  
241

**11.6.3 Technologies of Energy Crop Development and Utilization**  
242

**11.6.4 Technologies of Efficient Utilization of Major Agricultural Inputs**  
243

## 11.7 Achievements of China’s Agricultural Circular Economy Development

**11.7.1 Lowering Costs, Increasing Revenues, and Raising Agricultural Productivity**  
243

**11.7.2 Reducing Non-point Pollution in Agriculture, and Guaranteeing Food Safety**  
244

**11.7.3 Enhancing Energy Security in Rural Areas Through the Development of Biomass Energy**  
244

**11.7.4 Reducing Greenhouse Gas Emission Through Agricultural Circular Development**  
244

**11.7.5 Improving the Living Environment in Rural Areas**  
244

## References

245

## 12 “Urban Mining”

**12.1 The Concept and Implications of “Urban Mining”**  
247

**12.2 Development and Utilization of Urban Minerals in China**  
248

**12.2.1 The Policy and Regulatory Systems Concerned**  
248

**12.2.2 Technical Standards of Products and Criteria for Industry Access**  
252

**12.2.3 Development of the Comprehensive Waste Reutilization Industry**  
252

**12.3 Development of the “Urban Mining” Demonstration Bases**  
253

**12.3.1 Buildup of the “Urban Mining” Bases in China**  
253

**12.3.2 The Urban Mining Base of Miluo Industrial Park**  
255

**12.3.3 Tianjin Ziya Circular Economy-Oriented Industrial Park**  
258

**12.3.4 Tianying Circular Economy-Oriented Industrial Zone in Jieshou, Anhui Province**  
259

**12.3.5 Sichuan Southwest Resource Recycling Industrial Park**  
260