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CHINA'S ENERGY – SUSTAINABLE STRATEGIES

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ABSTRACT: The article refers to two issues within the semantic field of the concept of 'wenming' – i) civilising with Chinese characteristics and ii) relating to the subject of energy – CO₂ production in China. One of the dimensions of the concept of 'civilising' and the importance of sustainable production and consumption issues in the context of the deepening environmental degradation outlined our goal, which is to present the relationship between the civilised and the sustainable with Chinese characteristics as well as to analyse the level of CO₂ pollution. The effect of the above is an attempt to explore the Chinese perception of wenming and to identify regions which are closer to the idea of eco-civilisation. Three variables were adopted for the analysis: i) CO₂ emissions, ii) population in a given region, and iii) GDP in a given region. The analysis distinguished four clusters – groups of regions emerging from the dendrogram. Clusters that were isolated using the Ward method can contribute to more precise solutions to fight CO₂ emissions and conduct a more appropriate policy related to the possibilities and needs for the production of energy from renewable sources.

KEYWORDS: civilizing, ecological civilisation (eco-civilisation), energy, China, sustainable consumption and production, economic culture

Introduction

The paper inscribes the wider project of investigating the Chinese concept of *wenming* as one of the components of Chinese culture within the frame of societal engineering and economic culture (Mazur-Włodarczyk et al., 2024). The implementation of the conducted research would enable the analysis of one of the components of Chinese culture, *wenming*–(E.) ‘civilising’, from the point of view of elements that have a significant impact on the environment in which economic processes take place.

The Chinese lexeme ‘*wenming*’ [文明] is difficult to translate into other languages (see Mazur-Włodarczyk et al., 2024, for an overview). A “functional imbalance” has been identified between the term in Mandarin Chinese and its translations into English (Dranseika et al., 2018). Moreover, due to the fact that one of its meanings refers to the concept ‘civilisation’, *wenming* implies a connection with a very broadly defined, debatable and therefore differently understood category (Adamski, 2003), which is still being elaborated (Skoczyński, 1998). In dictionaries of the Chinese language, the characters 文明 imply not only the equivalent of ‘civilisation’ [文化], understood as the sum of wealth created by people, but also connote politeness, manners, and even ‘something new’, ‘something modern and western’.

The latter of these meanings gained popularity in the late Qing Dynasty and early Republic of China (Pleco Chinese Dictionary, 2024), but is not as prominent as it used to be. Li (2016) points to the etymology of the word 文化, meaning the action of ‘influencing others through argumentation’. Civilising (in the sense of ‘opening up’) in Chinese also appears in the characters 开化, while in the context of educating and transferring knowledge as 教化 (Działoszyński, 2018). Gabriele de Seta (De Seta, 2018) defines the term *wenming* as ‘citizenship’ and ‘civility’, contrasting this category with its negative form – *buwenming* [不文明] interpreted as ‘uncitizenship’ and ‘rudeness’. For the purposes of this article, it was decided to use the equivalent ‘civility’ [文明化]. In the literature on the subject, relating to the issue of civilisation and China, one can find three groups of interrelated issues related to i) perceiving China not as a country but as a civilisation; ii) developing socially moral behaviour within the socialist spiritual civilisation [社会主义精神文明]; and iii) transforming the natural environment: environmental (friendly) civilisation indicating the need to move towards creating an ecological civilisation [生态文明].

According to the planned policies of the Chinese government, the 21st century will be the century of China, the time when this country will be recognised as the leading civilisation of the world (Erbaugh, 2008). China [PRC] is the largest manufacturing country and the fastest-growing economy in the world. It is the most populous, energy-intensive country and also the main emitter of CO₂.

Scholarship devoted to China and energy can be divided into four groups of topics: i) energy production and consumption (Yu et al., 2019; Bao & Liu, 2019; Muhammed & Tekbiyik-Ersoy, 2020; Zhou et al., 2021; Liu et al., 2021; Chang et al., 2022), ii) the energy policies introduced and their effectiveness (Ma et al., 2022; Wei et al., 2022; Zhou et al., 2022; Mastoi et al., 2022a), iii) carbon emission related to coal mining or processing (Liang et al., 2019; Qu et al., 2022; Huang et al., 2022; Jing et al., 2022; Kou et al., 2022; Sha et al., 2022; Yang et al., 2022) and finally, iv) the impact of the Covid-19 pandemic on the energy sector (Mastoi et al., 2022b; Wu et al., 2022; He & Zhang 2022; Kostin et al., 2023). All of these topics are of global importance, especially from the point of view of the threat of global warming related to greenhouse gas emissions and the attempt to harmoniously link economic growth with a carbon-free economy. The issues of energy production and consumption are in line with the 12th Sustainable Development Goal – ensuring sustainable patterns of consumption and production. It is related to destructive human behaviour, which contributes not only to the degradation of the natural environment but also threatens further development and survival (UN, n.d.), minimising the carbon footprint. In the context of energy and China, this aspect mainly refers to moving towards a zero-emission economy, i.e., mainly carbon-free and reducing energy needs.

With the view of the above-exposed factors, that is, the aspirations of the PRC, the concept of environmental civilisation, and the importance of sustainable production and consumption issues in the context of deepening environmental degradation, the purpose of this text is to present the relationship between *wenming* and sustainability with Chinese characteristics. Another aim is to determine whether energy in China may be defined more as civilised or rather balanced. In order to achieve this, the article analyses the collected data related to the level of carbon dioxide pollution in selected

regions of the PRC. A cluster analysis was performed with the aim of identifying regions closer to the *wenming* perspective.

An overview of the literature

Wenming – terminological quandaries

The first character of the word *wenming* – 文 in its earlier form, depicted a man with a piece of text on his chest (Gu, 2008). This sign is associated both with writing, written language and Chinese characters, i.e. the main factors of civilisation (Działoszyński, 2018), and with the entire concept of culture through which civilisation manifests itself (Sickman & Soper, 1984). The character 明 [míng], on the other hand, refers to something bright, welllit, shiny and clear, like the sun [日] and the moon [月], or the light coming through a window [窗] or an eye [目] (Gu, 2008). Thus, the word *wenming* indicates that a person experiences the surrounding world, tries to remember it, and perpetuates it – to make it everlasting (see Mazur-Włodarczyk et al., 2024).

The purpose of perpetuation is to obtain knowledge based on which one can influence others to move in the right direction, to become possessors of certain virtues, and to be enlightened and civilised (Deng et al., 2014). So, being civilised means being transformed through writing (Nguyen, 2012). As far as the concept of civilisation' is concerned, it was initially defined as a set of features typical of a Roman citizen (Adamski, 2003). However, it is a relatively modern concept (created between 1759 and 1880), and its origin actually has French-Latin roots (Działoszyński, 2018). The importance of civilisation is related to the degree of development of society – its progress (economic, technical and/or social (Niwiński, 2017). It is also associated with a type of culture involving the knowledge of writing, the existence of cities, political organisation and the development of professional specialisations (Adamski, 2003).

Nonetheless, each of these semantic components has been questioned. For example, Fernandez-Armesto (2008) emphasises that denying the strictly agricultural societies the right to be described as *civilisation*, on the one hand, means invalidating a large part of the published works on this subject, and on the other, implies defying such elaborate ways of preserving information as knotted strings, corrugated sticks, reed maps, fabrics or gestures. Moreover, being civilised was once associated with only one kind of civilising (entailing the opposite of 'barbarism' and 'something primitive'). Currently, there are many civilisations which are civilised in their own way (Huntington, 2018).

Similarly, the combination of the concepts of 'civilisation' and 'culture' is associated with numerous differing opinions, which are manifested, among others, in treating civilisation as i) synonymous with culture, ii) the material exponent of culture, iii) culture as an intellectual and spiritual or intellectual and aesthetic sphere (including the opposite of culture), and iv) civilisation as a moral sphere; an advanced stage of culture; the declining phase of culture development; or as its specific type (Golka, 2012; PWN, 2007; PWN, 1987). Civilisation is also regarded as the course and sequence of given phenomena: a positive phenomenon (progress and enlightenment), a negative phenomenon (regression and corruption), as a synonym of universal history, its fragment, hypothetical history or as a general and complex fact (Działoszyński, 2018). Civilisation can also sometimes be defined as a larger and relatively homogeneous unit (Golka, 2012) without clearly defined boundaries (Huntington, 2018) or as a cultural area covering individual countries (Kłodkowski, 2014). For example, based on those criteria, the following civilisations were distinguished: Jewish, Brahmin, Chinese, Turanian, Arab, Byzantine and Latin (Koneczny, 1935). After 1990, one of the criteria of civilisation was based on a religious foundation, yielding the following civilisations: Western, Latin American, African, Islamic, Orthodox, Hindu, Buddhist, Japanese and Chinese (Huntington, 2018). According to Huntington (2018), civilisational borders are not always coextensive with state borders. Dividing lines may run through some countries, including India, Sri Lanka, Malaysia, Singapore, the Philippines, Indonesia and China.

Wenming as a derivative of a great civilisation

Regardless of the preferred typology of civilisations, the existence of one or two successive Chinese civilisations is generally confirmed (Huntington, 2018). The Chinese civilisation is characterised by the fact that it is one of the oldest in the world (Wetzels, 2008), and it was not formed on the basis of only one centre (DIALOG, 2009). Nonetheless, settlement and agricultural development owe a lot to great rivers, e.g. Yellow River and Yangzi (Dillom, 2009). Some sources point to important events that indicate the beginning and development of Chinese civilisation, such as the development of bronze alloy technology (Ropp, 2010) or an abundance of new ideas and philosophies (Rossabi, 2014). The literature on the subject also mentions that the key role in shaping the Chinese civilisation was played by the Han dynasty (206 BCE – 220 CE), during whose reign Confucianism was adopted as a state cult (Rossabi, 2014). The flourishing of this civilisation is related to the period of the Sui dynasty (589-618) and the Tang dynasty (618-907) (Morton et al., 2004).

In addition, Chinese civilisation is characterised by: flexibility, adaptive value, and mobility, influencing part of the rest of humanity through its ancient inventions (including paper, printing press, gunpowder and the compass) (Fernandez-Armesto, 2008). Furthermore, China being an Asian country, its cultural traits are marked by the conviction about the superiority of its own culture over the Western one, as well as linking the achieved economic success with the specificity of this culture, e.g., family values, discipline and the rejection of individualism (Huntington, 2018).

Contemporary theorising regarding the existence of the Chinese civilisation today falls into two veins. The first one assumes the continued perception of China as a civilisation rather than just an “ordinary state” (Góralczyk, 2013). The second refers more to the fact that China used to be a civilisation, and at the same time, civilisation was coterminous with China, which, as the Middle Kingdom (Zhōngguó), was the centre of the civilised world (Strittmatter, 2010). On the other hand, the return to perceiving the PRC as a great civilisation, in reference to its position as the strongest global power, has been the strategic goal of the PRC leadership from the very beginning. This included, e.g. focusing on the recovery of lands detached in the 19th century and the creation of a friendly/neutral zone around the country’s borders, encompassing countries previously dependent on China (Rowiński, 2011).

The introduction of a market economy in China spurred the implementation of the civilisation policy – the concept of *wenming*. Its aim was to smoothen the transition from the quantitative to the qualitative, from village to city, from classless society to middle class. Finally, the objective of the civilisation policy was to support the revival of “the grandeur of an ancient and glorious civilisation” (Romero, 2018). In 2006, an attempt was made in China to create a system of main socialist values, an equivalent of the socialist decalogue (Góralczyk, 2013), reflecting the values of the Constitution (Ma et al., 2015). This system includes “the guiding ideology of Marxism, the common ideals of Chinese socialism, the focus of the national spirit on patriotism and the spirit of the times on reform and innovation, and the socialist concept of honour and disgrace” (Li, 2016).

Twelve cardinal social values [社会主义核心价值观] were specified, with *wenming* being one of them. These values perceived as features can be grouped into three levels: 1. national [国家层面的价值目标]: prosperity and power (of the country) [富强], democracy (socialist) [民主], civilised (civilisation) [文明] and harmony [和谐]; 2. social [社会层面的价值取向]: freedom [自由], equality [平等], justice [公正] and rule of law [法治]; and 3. individual [公民个人层面的价值准则]: patriotism [爱国], dedication to work (respect for work) [敬业], honesty [诚信] and friendliness [友善]. The emergence of the concept of *wenming* was also accompanied by the evaluation of the concept of ‘quality’ [素质] (Romero, 2018), manifested in the orientation towards creating ‘quality citizens’ [人口素质] (Nguyen, 2012), that is a society aimed at transforming itself into a civilised society [文明社会].

The civilisation policy is still being continued in China. In the Fourteenth Five-Year Plan, referring to the plans for the socialist modernisation of China by 2035, the lexeme *wenming* appeared as many as 16 times. The phrases containing it refer to, among others, to (Xinhuanet, 2020):

- transforming China into a culturally advanced country,
- strengthening the cultural “soft power” of the country,
- improving civilised literacy,
- promoting the development of a civilised and healthy lifestyle,
- socialist spiritual civilisation,

- civilised fashion and behavioural norms,
- strengthening the construction of network civilisation and developing a positive and healthy network culture,
- strengthening the dialogue between civilisations,
- building an ecological civilisation.

Wenming as counteracting improper habits

Even in this approach to civilising/ civility, the political discourse used in China comes to the fore. It implies the building of a socialist society (socialist civilisation), in which ideological culture is described as the soul of the country and nation (Li, 2016). *Wenming* is thus a political concept aimed at establishing a classification system based on rather abstract categories that define a good citizen. Civilisation is, therefore, defined as a system of moral, hygienic and pragmatic values closely intertwined with the Confucian doctrine (Romero, 2018).

Contemporary spiritual civilisation with Chinese specificity refers to the specific behavioural habits of the individual. "If someone manages interpersonal relationships and participates in social interactions in a polite and reasonable way in everyday life, then his behaviour can be perceived as correct in terms of behavioural habits" (Li, 2016). From this point of view, the measure of civilisation is the awareness of the need to act according to socially established norms, manifested, among others, in waiting in lines, obeying traffic regulations, and not entering the personal zone of another person (Li, 2016). Ensuing from the above, the bad habits of PRC citizens include, among others: i) not standing in a queue (e.g. when entering public transport), ii) not giving up your seat to people with special needs – the elderly, the sick, people with disabilities, pregnant women and those caring for children (e.g. on public transport); iii) crossing the street in prohibited places, not complying with traffic regulations (especially ignoring red lights); iv) spitting, swearing, shopping in pyjamas (Strittmatter, 2010), v) too loud behaviour in public places, littering, or smoking in places marked with a nonsmoking sign.

In order to counteract these behaviours, a number of remedial actions were initiated in the 1980s, which in general related to educating citizens, for example, the elaboration and distribution of guides of correct behaviour. According to Erbaugh(2008), China has overtaken Europe in publishing courtesy guides that are not addressed to individuals but to the collective. They refer practically to each of the spaces mentioned above. From 1980, among others, they also subsumed verbal hygiene, that is, the use of civilised and polite language, including the use of the five main honorifics: good morning [你好], please [请], sorry [对不起], thank you [谢谢], and goodbye [再见] (Erbaugh, 2008).

Social, educational lessons were also held in Shanghai during the Expo 2010 World Fair, where fans decorated with slogans encouraging them to behave like a civilised visitor [文明观博] were distributed. To wit, according to those stipulations, a civilised visitor is one that does not cut lines and patiently waits for his turn [耐心等待不插队]; takes care of the exhibits he does not touch [爱护展品不乱碰]; segregates garbage and does not litter [垃圾分类不乱扔]; does not smoke in prohibited areas [控烟区域不吸烟]; accepts gifts (freebies) without fighting [领取赠品不争抢]; does not make noise and uses civilised language [言语文明不喧哗]. Currently, in the public space of Chinese cities (See Mazur-Włodarczyk et al., 2024).

The concept of *wenming* also penetrates the digital media space, in which context it is described as a catalyst for the development of local civil society. A new category of civilisation has appeared directly related to the Internet – the civilised use of the global network [文明上网], as well as the attitude of a good Internet user (De Seta, 2018) – a civilised Internet user [文明网民]. However, this category contains not only references to opposing vulgarity, respecting others and other behaviours shown in international netiquette but also the admonition not to publish information that could threaten, among others, national security, undermining social stability and social morality (Department of Human Resources and Social Security of Henan Province, 2021; Wdqwzzb, 2020).

Civilizing as transforming the natural habitat

The perception of civilisation through the prism of man's transformation of the natural habitat is one of the criteria for defining civilisation, as proposed by Felipe Fernandez-Armesto. The researcher conceptualises civilisation as a relationship between man and nature. He also notes that any habita-

ble environment can become the basis of civilisation (Fernandez-Armesto, 2008). However, the rapid pace of industrialisation and economic development has consequences for the natural environment. Social and economic development is accompanied by a number of negative phenomena, among which the most severe is ecological degradation. The consequences of changes in the natural environment are felt not only by man (present and future generations) but also by the rest of the surrounding world. Fears of further serious consequences of this degradation may come true, as warned not only by studies, scientific reports and forecasts (Warren et al., 2005; Glavovic et al., 2021; WWF, 2020; UN Environment, 2019) but also by science fiction texts presenting views from the future (Oreskes & Conway, 2018).

The overexploitation of its natural resources spurred China's efforts to transform the industrial civilisation [工业文明] into an ecological civilisation [生态文明]. According to I-Shin Chang's team (Chang et al., 2019), these activities began in China as early as 1973, and after a decade, they were indicated as the basic policy of the PRC. In 1994, the Chinese White Paper was published, taking into account the sustainable development strategy in the long-term planning of social and economic development. The category of ecological civilisation appeared in political speeches in 2007 (DeJong, 2019) as a kind of vision of sustainable development with Chinese specificity, deeply rooted in and explained by references to elements of traditional Chinese culture. These Chinese features refer to both the Confucian concept of 'harmony' – unity between man and nature [天人合一], as well as the Taoist idea of following the path of nature (Schönfeld & Chen, 2019), the order of the universe [道] (Pipmaneau, 2001). In the Confucian view, man, as a social being, naturally strives to build civilisation. In contrast, in the Taoist view, civilisation is not something natural, so it is not a goal to be pursued (Lee, 2010). In 2015, China elaborated on the project of building an ecological civilisation, enabling the harmonious coexistence of man and nature so as to ensure the safety of health, life and property and to maintain social stability (Chang et al., 2019).

Creating an ecological civilisation is described as a major challenge, especially in terms of maintaining the spirit of cooperation and increasing citizens' awareness of environmental issues and the involvement of the second and third sectors (Kuhn, 2019). A gap is noticeable in the implementation process, especially in urban areas where various environmental challenges are exacerbated (DeJong, 2019). Researchers from outside the PRC point out that ecological civilisation is not just a political slogan used by politicians as a constitutive element of socialism with Chinese features for the new era, but it actually translates into the socio-economic transformation of the country (Gordon, 2018).

Ecological socialism (Schönfeld & Chen, 2019) does not treat everyone on an equal footing with sustainable development, which is mainly due to its political connotations (Garre, 2012). Research conducted by Flato (2021) shows, among others, that air pollution is mainly detrimental to gaining popular political support, especially at the county and provincial levels. Because of this, public statements related to sustainability mostly focus on publicising problems and potential quality-related considerations. As a result, slogans promoting civilisation combined with ecological aspects can also be found as urban cape decorations.

The need to increase civic awareness, especially about one's own role in the process of caring for the natural environment, is also emphasised by Chinese researchers (e.g. Yu, 2019). This is usually voiced in the context of the strategic building of a modern and powerful Chinese state. Scholars emphasise, e.g. the role of the young generation and the importance of educational activities aimed at raising environmental awareness, the level of responsibility and respect for the natural order (Yu, 2019), as well as the need to care for Chinese nature parks (Jiao, 2019).

Research methods

The study was developed in three stages. The first one was based on the desk research method, that is, exploring the literature on the subject of Chinese civilisation. The second stage was data collection in order to create a research corpus. The database was obtained through a manual search of internet resources, in particular, published research on energy production and consumption in China for particular regions. For the purposes of this paper, we focused on the years 1997, 2007 and 2019. This selection, while retaining the representative scope appropriate for a research paper, also gave us a longitudinal dimension. The final stage involved performing cluster analysis using the Ward method

on the relevant data excerpted in stage two. The Ward method belongs to the group of agglomerative methods and is more appropriate for variables of a quantitative nature. It makes use of the analysis of variance to estimate the distances between clusters. The distances of the new cluster from all others are determined through the Euclidean distance using a formula:

$$d_{i,j} = \left\{ \sum_{l=1}^m (x_{i,l} - x_{j,l})^2 \right\}^{1/2}, \text{ for } i \neq j, \tag{1}$$

where:

- m – number of variables,
- k – number of analysed attributes,
- Z_{ij} – standardised variable.

In order to make the variables comparable, the following attributes are standardised:

$$Z_{ik} = \frac{x_{ij} - \bar{x}_j}{S(x_j)}. \tag{2}$$

where:

- X_{ij} – the value of the i -th object relative to the j -th variable,
- \bar{x}_j – arithmetic mean of the j -th feature calculated on the basis of all objects,
- $S(x_j)$ – standard deviation of the j -th variable.

Figure 1. A diagram juxtaposing research procedures with excerpted corpus content

The calculations were made using the Statistica program in the cluster analysis module. Three variables were adopted for the analysis: i) CO₂ emissions, ii) population in a given region and iii) GDP in a given region.

In the first phase, the variables were standardised according to the above assumptions. Then, connection trees were created, which are the graphical visualisation of the conducted research. Combining subsets is crucial in the context of agglomerative clustering methods. Among the various approaches to integrating, the most frequently used are the nearest neighbour method (single), the farthest neighbour method (complete), the average element distance method (average), and the Ward method, which was used in our calculations. Ward’s method takes into account the structure of the data and minimises the variance within groups. It is also relatively less susceptible to the influence of noise in the data than other methods. In the Ward method, the joining criterion is the minimum value of the variance of the newly created group. The subsets available in a given step are combined in pairs into new groups, and the variance value is calculated for each. Among the groups thus created, there is one with the least variance. This is the final group created in this step. The procedure is iterated until a group that includes all elements of the initial set is obtained and subjected to cluster analysis. The more similar the regions are to each other, the earlier they merge, forming a similarity hierarchy where lower-order clusters are part of higher-order aggregations. Depending on the assumptions of the study,

Material and Methods			
Search	Database/ Methods	Web of Science, Research Gate; Desk research	National Bureau of Statistics of China, World Bank, BP Statistical Review of World Energy; Desk research
	Keywords	1. Wenming; civilisation + China; ecological civilization + China; 2. energy + China; China power sector	Energy + China
Appraisal	Inclusion criteria	Open access	The most recent numerical data; data covers the division into provinces; open access
	Content criteria	Materials relevant for the research	Materials relevant for the research
Synthesis	Categorisation by application and impact area/ Methods	1. Wenming: - as a derivative of a great civilization; - as counteracting immoral habits; - as a transformation of the natural environment. 2. Energy: - energy production in China; - energy consumption in China.	Cluster analysis using the Ward method. Variables: - CO ₂ emissions, - population, - GDP.
Analysis	Insights	Linking civilization/ civilizing with sustainability in terms of energy	Linking civilization of the regions in relation to CO ₂ emissions
		Results; Discussion; Conclusions	

including, in particular, the accepted Euclidean distance between objects, larger or smaller clusters can be distinguished. A smaller or larger number of them. The study included a division with a bond distance of 4, giving 4 aggregates of regions in 1997 and 2007 and 5 aggregates in 2019. It should be added that clusters at this level of grouping were interpreted in the order resulting from the shortest Euclidean distances between objects.

Details on the algorithm of research procedures are presented in Figure 1.

Results of the research

Civilising as a focus on reducing CO₂ production

In 1973, China accounted for 7.1% of the world’s total energy supply. In 2019, this value increased to 23.5%. The country is also the largest producer of coal in the world (49.7% of global production) and its largest net importer (IEA, 2021). Between 1997 and 2018, China’s energy production increased from 13.3 Gtce to 37.7 Gtce in 2018 (the above is shown in Figure 2). In 2018, the national primary energy production totalled 3.77 Gtce, which breaks down as follows: raw coal 69.3%, crude oil 7.2%, natural gas 5.5%, and primary electricity and other energy 18.0%. These data are juxtaposed in Figure 3.

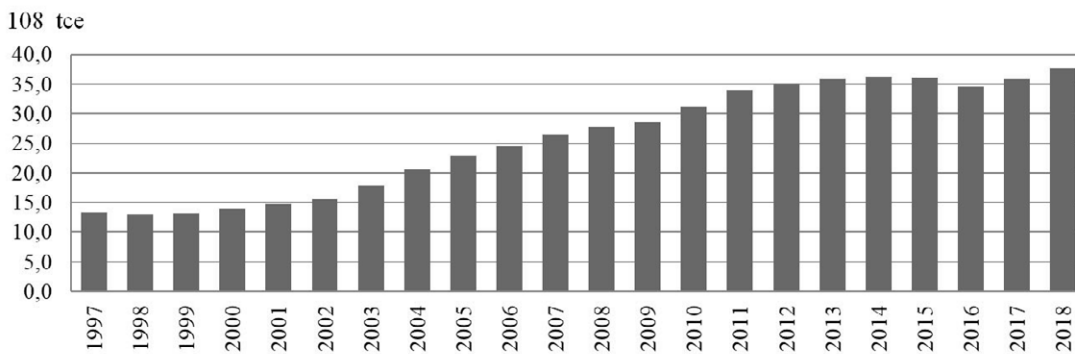


Figure 2. Total primary energy production in China, 1997-2018

Source: NBS (2018).

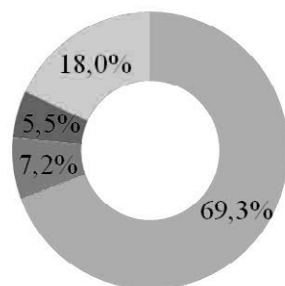


Figure 3. Primary energy production and composition in China, 2018

Source: NBS (2018).

China is also the world’s largest energy consumer, accounting for 23.6% of global energy consumption. China has ranked first in global energy growth for 18 consecutive years since 2001 (BP, 2019). China’s total primary energy consumption was 4.64 Gtce in 2018, an increase of 3.4% relative to the previous year. Coal dominates China’s energy consumption, accounting for 59.0% of total primary energy consumption in 2018. Since 2011, the share of coal consumption in total primary con-

sumption has been steadily decreasing. In 2011, the percentage share of coal consumption was 70.2% (shown in Figure 4).

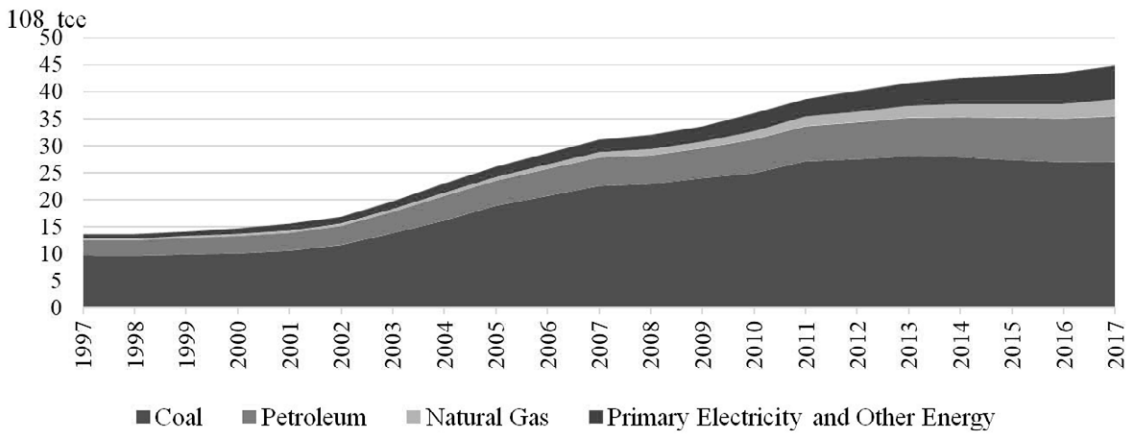
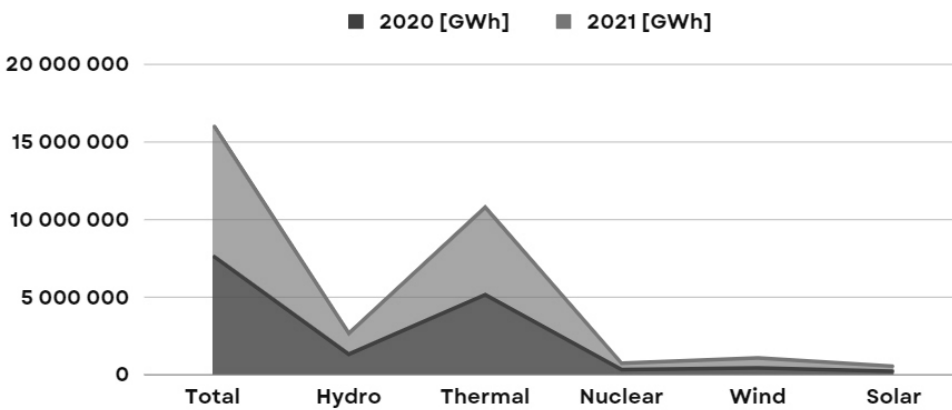
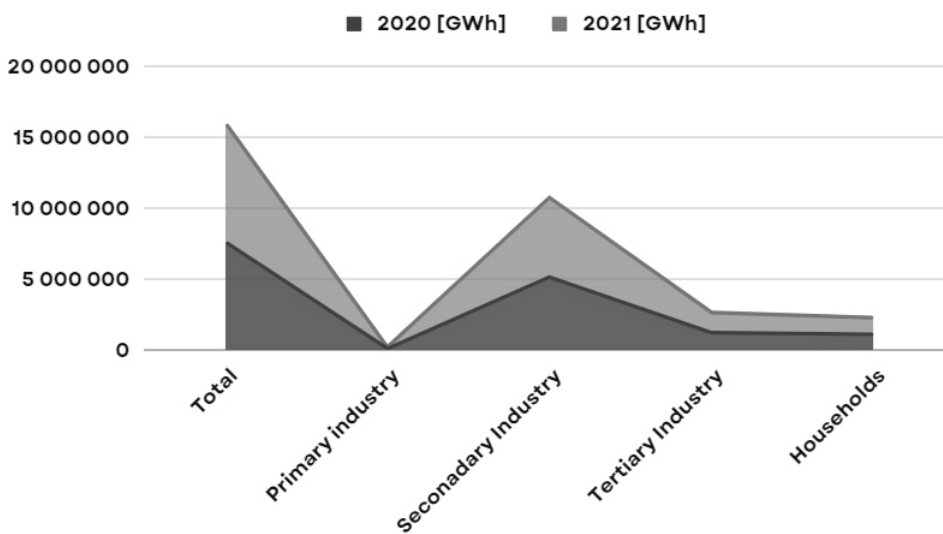


Figure 4. Total primary energy consumption by fuel in China 1997-2018
Source: NBS (2018).



(a)



(b)

Figure 5a-b. Production (a) and consumption (b) of energy in China in 2020 and 2021 [GWh]
Source: China Energy Portal (2022).

China also leads the statistics as the world's largest producer of solar photovoltaic electricity (32.9%), hydroelectricity (30.1%) and wind electricity (28.4%). PRC is the third largest producer of nuclear electricity (12.5%) and the fourth of natural gas (4.8%). Thus, China is not only the largest producer of coal energy (4876 TWh) but also a producer of energy from renewable sources (2015 TWh) (IEA, 2021). Figure 5a-b presents data related to the production and consumption of energy in China in 2020 and 2021. The production space is dominated by thermal energy, including coal, gas, oil, and biomass, followed by hydro, wind, nuclear, and solar energy. The biggest changes between 2020 and 2021 are noticeable in the areas of elevator energy production (increase by 40.5%), solar (25.2%), and nuclear (11.3%).

The segment that is most energy intensive is the industry, primarily the sector processing raw materials. It is followed by the service sector. In this space, the largest increase was recorded in the services sector (an increase of 17.8%), primary industry (16.4%), and secondary industry (9.1%). Comparing the total change in energy production (9.8%) and its consumption (10.3%), a greater increase in energy demand can be seen (see Figure 5a-b).

Over the past two decades, coal consumption has increased significantly in Asia. Both the COVID-19 pandemic and the accompanying market blockade, as well as the situation related to the Russian-Ukrainian war, affected the demand for coal. China at that time recorded an increase in its demand (Aguirre-Villegas & Benson, 2022). Moreover, forecasts point to a further increase in energy demand in all sectors in China (IEA, 2022). Coal is the dominant energy source in China, accounting for about 60% of its total consumption. The above implies that China's contribution to global greenhouse gas emissions amounts to almost 1/3 (that is, about 28% of greenhouse gases are produced in China).

Apart from carbon dioxide (CO₂) emissions coming mainly from coal combustion, coal mining is also accompanied by the release of other gases, e.g. methane (CH₄) (Xie et al., 2022), with the largest anthropogenic emissions coming from coal mines in China (Zhu et al., 2022).

In particular regions of China, from 1997 onwards, there has been a significant increase in (CO₂) pollution. Figure 6a-c shows (CO₂) emissions for 30 provinces. In the period from 1997 to 2019, total domestic emissions increased by 270.1%, reaching values from 2936 to 10864 million tonnes. Of the 30 provinces, Shandong emitted the most CO₂ – 13,780 million tons (8.62%). The next three provinces with the highest cumulative emissions are Hebei, Jiangsu and Inner Mongolia, which emitted 12,754 (7.98%), 11,147 (6.98%) and 9,036 (5.65%) million tonnes of CO₂, respectively.

China is currently increasing its CO₂ emissions. Chinese researchers emphasise the contribution of the Chinese side to the pursuit of sustainability by introducing national political priorities related to CO₂ emissions and climate change, dedicated respectively to new industrialisation, circular economy, resource-saving and environmentally friendly society, low-emission development, ecological civilisation building and strategic goals set for 2030 and 2060 (Zhou et al., 2022). These goals set in 2020 are related to reaching the peak of CO₂ emissions by 2030 and, in the next 30 years, by 2060, fully transforming into a carbon-free economy.

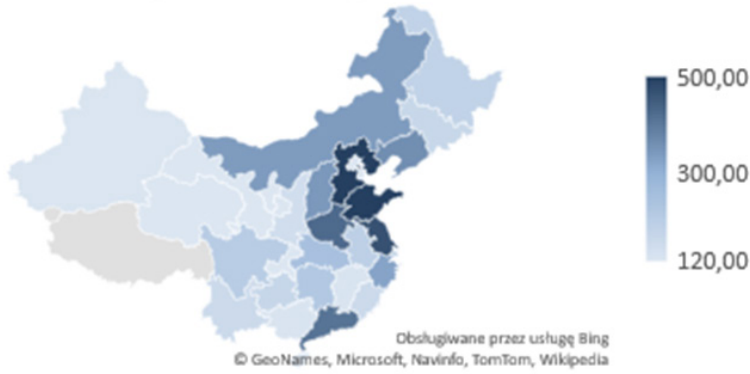
The 14th Five-Year Plan [“十四五”] is a period within which it is also planned to create a middle-class society in China. The development of renewable energy until 2035 is treated as a sine qua non to build an ecological civilisation and pursue sustainable development. Currently, its contribution to the increase in energy consumption is still lower than the global average (China Energy Portal, 2022). In order to achieve these goals, non-fossil energy is also planned to account for 20% of primary energy consumption and 39% of total energy production by 2025 (Wei et al., 2022). This is also facilitated by adhering to the following principles: innovation, multiple iterations, system concept, following market forces, synergy and integration, and ecological priority (China Energy Portal, 2022).

China provincial CO₂ emission in 1997



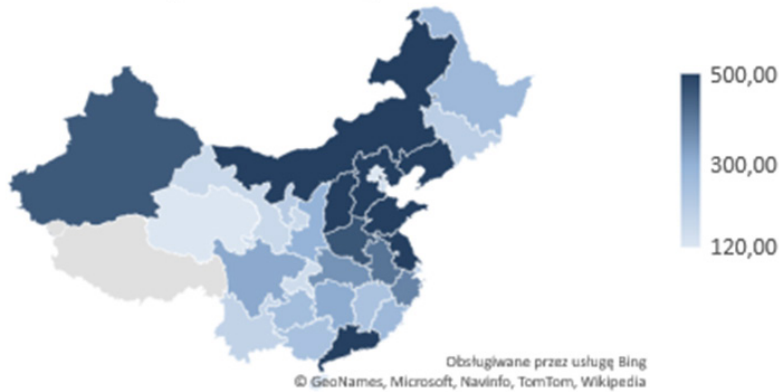
(a)

China provincial CO₂ emission in 2007



(b)

China provincial CO₂ emission in 2019



(c)

Figure 6a-c. CO₂ emissions from 30 provinces in China in 1997 (a), 2007 (b), and 2019 (c)¹

Source: Carbon Emission Account and Dataset (2023).

¹ Supported by Bing service. ©GeoNames, Microsoft, Navinfo, TomTom, Wikipedia (this is a translation of the Polish language captions from the figure).

Cluster analysis results

The data presented supra indicate a large discrepancy in CO₂ emissions in individual regions. As indicated in the introductory sections, cluster analysis using the Ward method was carried out for the data excerpted for three years with more or less a decade span: 1997, 2007 and 2019 for three variables: i) CO₂ emissions, ii) population in a given region and iii) GDP in a given region. The dendrogram of the degree of similarity of regions, made for CO₂ pollution, population and GDP level in 1997, showed that the first subdivision [I] was created by 3 regions: Hainan Qinghai and Ningxia (illustrated in Figure 7). These regions had the lowest level of CO₂ pollution, had a low population, and generated the lowest level of GDP. The second grouping consisted of regions with a very high level of CO₂ pollution, inhabited by a large number of people and generating the highest levels of GDP. It consists of the provinces of Sichuan, Henan, Guangdong, Jiangsu, Hebei and Shandong. The third emerging cluster subsumed regions with a fairly high level of CO₂ pollution, inhabited by a large number of people and generating high levels of GDP (provinces: Heilongjiang, Hunan, Hubei, Zhejiang, Anhui, Liaoning and Shanxi). Cluster 4 was the most numerous as far as constitutive provinces are concerned, as it was made up of 14 regions (Beijing, Chongqing, Tianjin, Gansu, Yunnan, Shanghai, Jilin, Jiangxi, Guangxi, Guizhou, Fujian, Shaanxi, Xinjiang and Inner Mongolia). They were characterised by a fairly low level of CO₂ pollution, inhabited by an average population, and generated low levels of GDP.

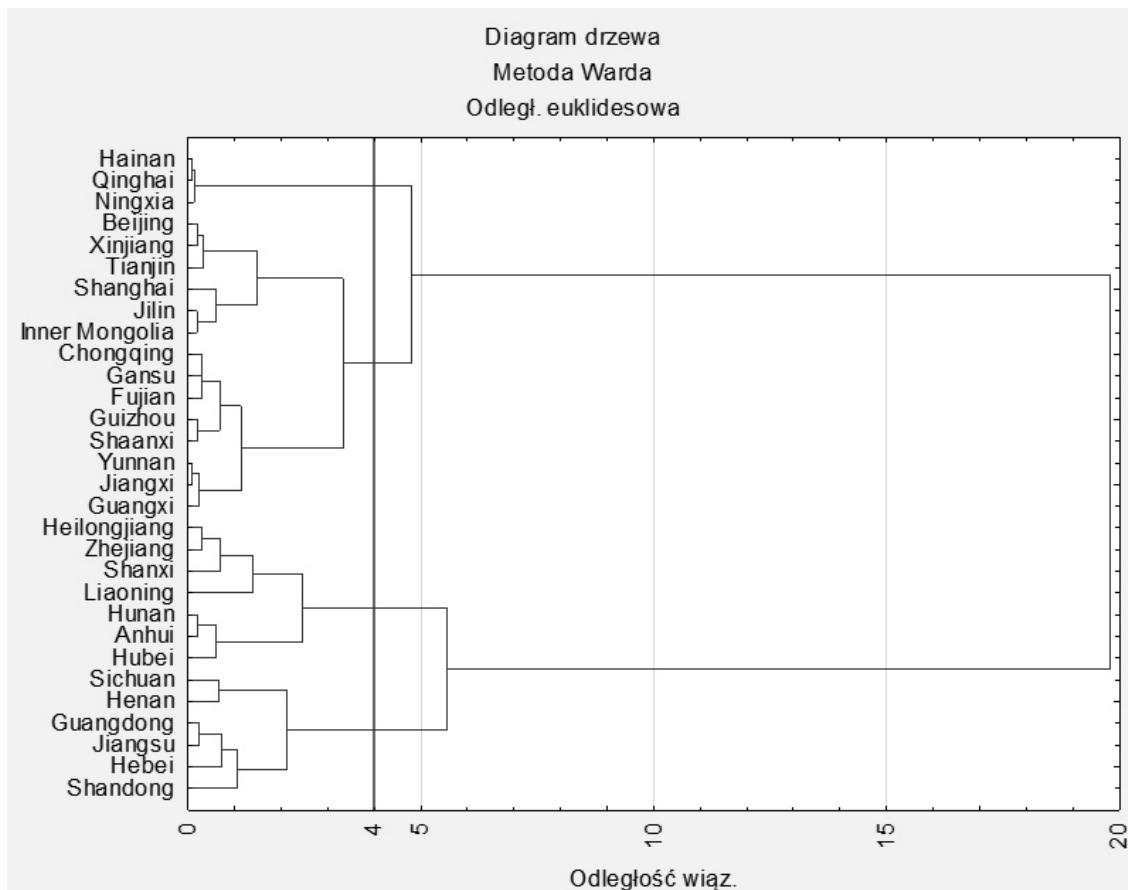


Figure 7. Relationships of regions according to the Ward Method for data from 1997²

The dendrogram of the degree of similarity of regions prepared for 2007 was very similar to 1997 in terms of the constitution of the regional cluster groups, which is shown in Figure 8. However, in 2019, the situation of the regions changed significantly and the following groupings were distinguished they (Figure 9: Group 1 – Hainan Qinghai, Tianjin, Gansu, Jilin, Ningxia – the lowest level of

² Tree diagram; Ward method; Euclidean distance (this is a translation of the Polish language captions from the figure).

CO₂ pollution, with a low level of population and generated the lowest level of GDP; Group 2 – Guangdong, Jiangsu, Shandong – with a very high level of CO₂ pollution, inhabited by a large number of people and generating the highest levels of GDP; Group 3 – Hunan, Sichuan, Hubei, Zhejiang, Anhui, Henan –the average level of CO₂ pollution, with a large population and generating average levels of GDP; Group 4 – Beijing, Chongqing, Yunnan, Shanghai, Jiangxi, Guangxi, Guizhou, Fujian, Heilongjiang, Shaanxi – quite low level of CO₂ pollution, with an average population and generating average levels of GDP; Group 5 – Xinjiang, Liaoning, Shanxi, Inner Mongolia, Hebei – high level of CO₂ pollution, average population and quite a low level of GDP generation.

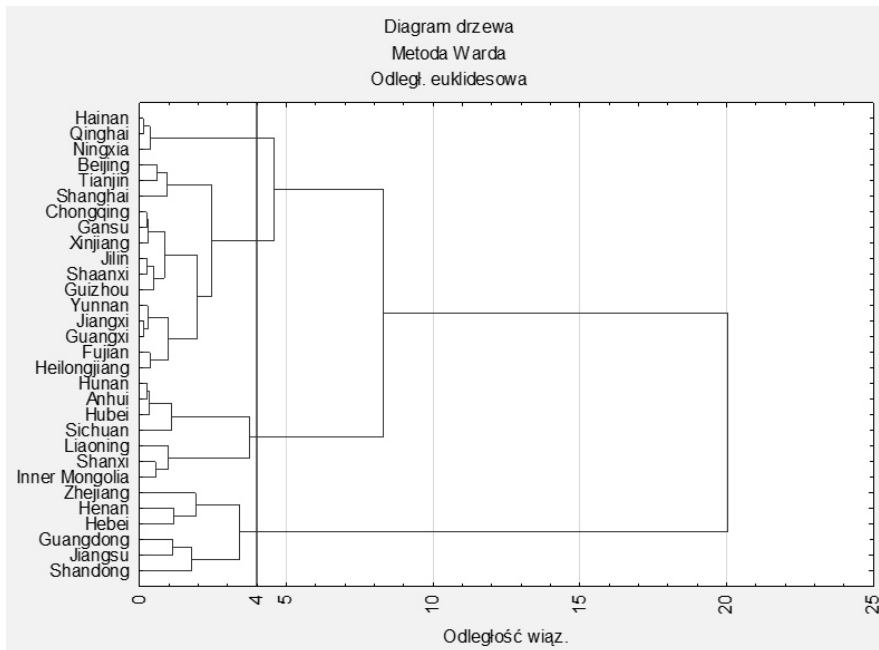


Figure 8. Relationships of regions according to the Ward Method for data from 2007³

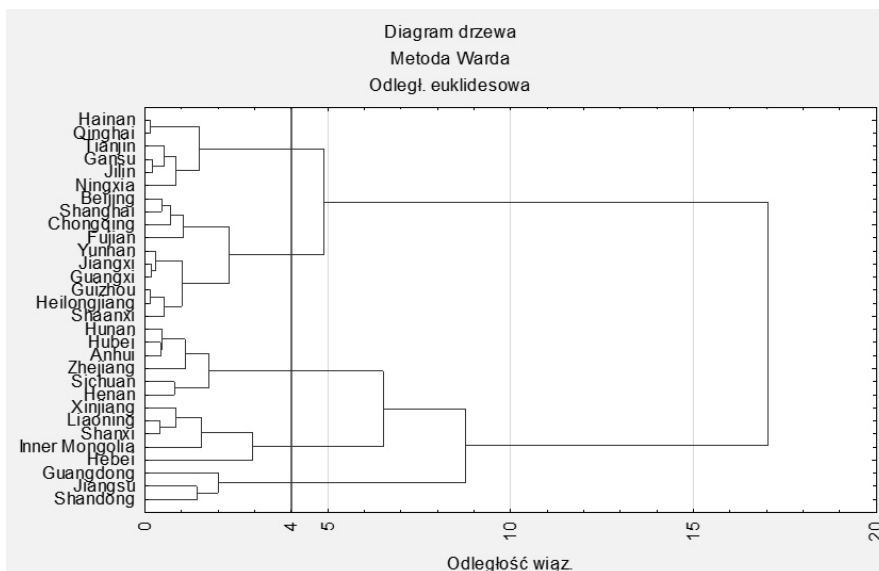


Figure 9. Relationships of regions according to the Ward Method for data from 2019⁴

³ Tree diagram; Ward method; Euclidean distance (this is a translation of the Polish language captions from the figure).

⁴ Tree diagram; Ward method; Euclidean distance (this is a translation of the Polish language captions from the figure).

The analysis of the spatial differentiation of pollution in CO₂ regions, taking into account the level of population and GDP generation according to the minimum Ward variance in the analysed years (shown in Figure 10a-c), allowed us to spot certain regularities. There was a general division of regions into areas with a high level of pollution, inhabited by a large number of inhabitants and generating high GDP values in all the analysed years – these are the regions of Shandong, Guangdong, Jiangsu, and Hebei, Sichuan and Henan in 1997 and 2007. The least threatened with the largest CO₂ pollution are the following regions: Hainan, Qinghai and Ningxia, to which in 2019, the regions of Tianjin, Gansu and Jilin were added.

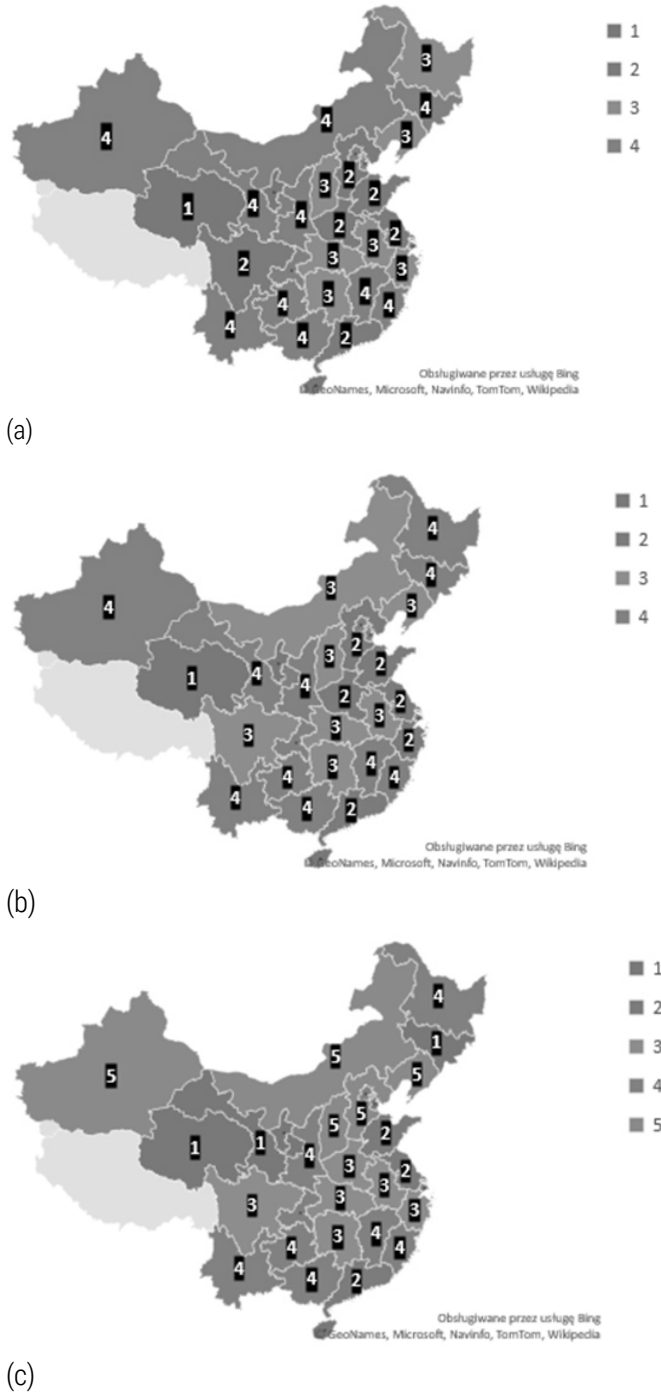


Figure 10a-c. Spatial differentiation of CO₂ pollution in regions in relation to the population of the region and the level of GDP according to the Ward method in 1997 (a), in 2007 (b), in 2019 (c)⁵

⁵ Supported by Bing service. ©GeoNames, Microsoft, Navinfo, TomTom, Wikipedia (this is a translation of the Polish language captions from the figure).

Discussion – Inscribing into the critical chorus

Energy aspects

Ge et al. (2022), analysing the data of individual Chinese provinces from 2010-2017 in the field of energy security, energy equity, and environmental sustainability, noticed that provinces located in the East of China are characterised by large renewable and nuclear energy resources. This, as the scholars claim, was due to greater investments in rapid economic development, environmental protection, energy saving and advanced energy technology. The above had an impact on the formation of reasonable energy prices and energy efficiency. Although the provinces located in the West have resource reserves, most of the provinces are economically underdeveloped without adequate investment in environmental protection. In addition, the scholars point out that the situation has generally improved over the period under review. The eastern part of China has experienced a significant transformation, moving from a state of conflict between energy security, energy justice and environmental sustainability towards coordinated development. The exception is the province of Yunnan, located in the South, in the central part of China (Ge et al., 2022).

However, many researchers emphasise the necessity of further energy transformation in China. The reliance on fossil energy is mainly noticeable in the north of China, while the reliance on water resources for energy production is mainly noticeable in the east of China. Similarly, solar and wind energy sources are unevenly distributed in the country.

In 2021, the main reasons for the power shortage were overreliance on renewable energy and insufficient coal supply to the power system. It is, therefore, important to develop diversified energy sources and increase the capacity to secure energy supplies (Wang et al., 2022).

Subsidies to industry, which have been introduced over the last three decades, have shown a reduction in the share of coal energy in China by about 20% (Xie et al., 2022). In 2020, China's electricity production (breakdown by fuel) was as follows: thermal (68%), hydro (18%), wind (6%), nuclear (5%), and solar (3%). The development of the renewable energy sector began with investments in hydropower. Subsequently, the demand generated by Western countries spurred the "vogue" for photovoltaic (PV) panels, in the production of which China soon began to specialise.

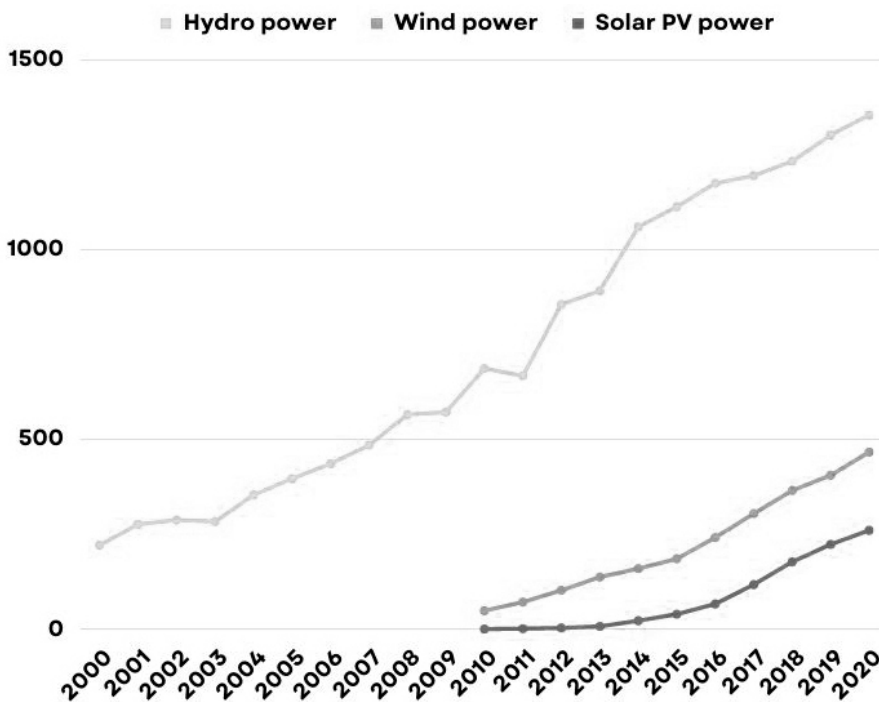


Figure 11. Power generation of the most widespread renewable energy sources in China [TWh]

Source: Energiepartnerschaft (2021).

Figure 11 shows the power generation of the most widespread renewable energy sources in China in the years 2000-2020. An alternative to coal is also biomass, which is a renewable raw material for the production of biofuels. The study by Ren et al. (2022) indicates, among others, that the improved level of mechanisation of agriculture in China, the level of construction of rural infrastructure and the level of rural economic development is conducive to the use of high quality energy from straw.

Western China (Yunnan, Guizhou, Sichuan, Chongqing and Tibet) has high hydropower resources. The photovoltaic energy in China, which has the largest installed capacity, is located in the provinces of Shandong, Hebei, and Anhui. Projects involving combining photovoltaics and wind power are located in the Gobi Desert and other desert areas (Han & Chang, 2022). Forecasts by the Han and Chang (2022) team indicate that clean energy production is expected to grow by about 10% annually in China. China's 2030 and 2060-oriented goals are feasible and may have an impact on, among others, reducing pollution, reducing the operating costs of enterprises, reducing the cost of pollution control, and reducing dependence on traditional energy imports. On top of that, those targets implicate being a symbol of creating a modern industrial civilisation (Han & Chang, 2022).

Water is the main source of renewable energy in China. The largest onshore wind/solar energy bases are located in the northern part of China (provinces: Heilongjiang, Xinjiang, Inner Mongolia, Gansu, Shanxi and Hebei), wind energy bases are in the eastern part (provinces: Jiangsu, Guangdong, Fujian, Guangxi and Shandong), and the largest integrated hydropower/wind/solar bases can be found in the south of the country (provinces: Guizhou and Yunnan and Xinjiang) (Lee & Zhao, 2022). However, according to Mastoi et al. (2022a) current policies and mechanisms introduced in China do not provide sufficient incentives for the development of renewable energy sources. Gao et al. (2021) indicate the following actions that should be implemented in the PRC: i) an optimised energy system should be created in the Yangtze River Delta, ii) a base for the production, storage and transport of clean energy should be built in the Pearl River Delta, iii) central China should become an integrated energy centre and iv) in Western China, the consumption of clean energy should be promoted. Kou et al. (2022) however, note that China can only phase out coal if coal-related businesses and society can benefit from reducing coal production and consumption. These benefits should also ensure stable economic and social development without affecting people's daily lives. The withdrawal from coal does not mean an immediate change, it will keep occupying (in the short term) an important position in the Chinese energy system.

The results of research conducted by the team of Huang et al. (2022) show that over the years 1955-2019, the factors affecting CO₂ emissions have included population size, GDP per capita, investment intensity and urban expansion. In addition, the efficiency of investments, the level of technology and the combination of these elements are the most important factors holding back the development of CO₂ emissions (Huang et al., 2022). The second largest source of CO₂ emissions is transportation. Research conducted by Jing et al. indicates that the level of development of public transport and CO₂ emissions are negatively correlated. The CO₂ emission reduction effect of the level of public transport development is more significant in the central and western regions than in the eastern and north-eastern regions of China. So, it is worthwhile implementing green modernisation of transport infrastructure and promoting low-emission production and CO₂ reduction (Jing et al., 2022).

Distortions in the prices of coal, oil, natural gas and renewable energy significantly contribute to the increase in CO₂ emissions. In addition, technological innovation, industrial structure upgrading, investment effect, energy consumption structure optimisation, and environmental protection regulations are important transmission mechanisms of energy price distortions affecting China's economic growth and CO₂ emissions. If actual energy prices deviate from the equilibrium level in a perfectly competitive market, this means that energy is not optimally allocated, and prices are defined as distorted, i.e. not reflecting the actual supply and demand. The above has a negative impact on China's economic growth and the reduction of carbon dioxide emissions (Sha et al., 2022).

In addition to investing in renewable energy sources, the opportunities for sustainability in this space are also related to increasing regional innovation efficiency, which has a negative impact on the ecological footprint (Zhang & Ke, 2022). This footprint is interpreted as a per capita 'green expenditure' of 3.8 gha per person in China in 2018, resulting in a biocapacity deficit of minus 2.9 gha (GFN, n.d.). The size of the ecological footprint may depend on innovation in a given area, e.g. the diversity of the ecological footprint within innovative and noninnovative cities (Zhang & Ke, 2022). However,

the most important thing is to introduce solutions to environmental problems not only after the development of the economy but at the same time – in the course of it (Zhang et al., 2022a).

Studies conducted by Liang et al. (2022) based on scenario simulations, indicate, among others, that the introduction of a carbon tax and carbon trading may result in a short-term reduction of CO₂ emissions and that the achievement of the targets planned for 2030 and 2060 may cause the collapse of the economic system. According to those researchers, the solution is primarily to create climate-friendly technological progress (Liang et al., 2022). However, according to Wei et al. (2022) reduction of fossil fuel subsidies (FSB), reduction of renewable energy costs (REC), resource taxes (RTX) and renewable energy portfolio standards (REP), as well as a combination of these principles, can reduce CO₂ emissions in China by 2.57 billion tones in 2060, but their effectiveness is not uniform. Reducing renewable energy costs may be most effective, followed by renewable energy portfolio standards and CRP (Wei et al., 2022).

In addition to solutions emphasising the importance of renewable energy sources, characterised by lower intensity of greenhouse gas emissions, another opportunity to achieve sustainability in the energy space is the control of energy consumption (Bao & Liu, 2019) and minimising energy intensity. Research by Zhang et al. (2022b) focusing on the mechanisms of the impact of industrial intelligence on energy intensity indicates that the use of artificial intelligence can reduce it. An additional factor affecting energy efficiency is the ownership structure – within Chinese state-owned enterprises, environmental performance is better than that of foreign-funded enterprises and private enterprises (Zhang et al., 2022b). Energy efficiency is also fostered by the implementation of smart city projects, under which energy consumption per unit of GDP decreases and its effects increase over time (Tu et al., 2022).

Regional differences aspects

The performed analysis showed how CO₂ consumption looks in different regions in China. In order to make the similarities between the regions more precise, an analysis of the clustering of regions was performed in relation to the number of populations and the generated GDP. It turned out that there are groups where there is little pollution with high levels of GDP, or there are regions with high levels of CO₂ pollution and high levels of GDP. The results of the research also pinpoint the changes that have been taking place in China over the years within the researched issues.

Analysing the fluctuations in the CO₂ production space in China, we can see that there is a change in the situation related to CO₂ emissions. In terms of the entire country, the emissions increased over the years 1997–2019. However, the clusters identified by means of the Ward analysis within regions of China indicate that ecocivilisation in China is progressing unevenly throughout the area. Identifying such clusters can contribute to more precise solutions to fight CO₂ emissions within individual areas. Moreover, it can foster the implementation of appropriate policies that are related to the possibilities and needs for the production of energy from renewable sources, taking into account the specific economic situation of each particular region. In the long run, the project will allow the recognition of Chinese civilisation's particular features in the following aspects: contemporary interpretation, shaping factors, place in the hierarchy of values, and economic activity.

Chinese ecological civilisation was simultaneously studied from the perspective of environment and health by the team of Guo et al. (2024) comparing composite environmental health index. They showed that introducing ecological civilisation results in a significant and lasting improvement in the ecological environment while maintaining a constant pace of economic development. However, due to issues such as an ageing population and exposure to past air pollution, only modest progress has been made in population health. These results were also not evenly distributed across China, with the highest progress observed in the eastern regions (Beijing and the provinces of Guangdong, Jiangsu, Shanghai, and Zhejiang). The northeastern and northwestern regions (provinces Heilongjiang, Jilin, Liaoning, Shanxi, Gansu, Ningxia, and Qinghai) witnessed limited progress, while the weakest results were observed in the western regions. Guo et al. (2024) also believe that efforts should be intensified in the western and central areas to improve their response subsystems, including increasing local investments in scientific research and protecting intellectual talents.

In this respect, some researchers also suggest introducing pilot ecological civilisation zones in selected areas to demonstrate and implement the method of small, safe steps and test new solutions in smaller, model areas. According to researchers from the team of Li et al. (2022), this may encour-

age the creation of a path for the development of ecological civilisation adapted to the specific conditions of China. This team also proposes implementing different policy combinations for other regions and adapting them to local conditions (Li et al., 2022). In the context of the energy industry, pilot ecological civilisation policies contribute to the reduction of greenhouse gas emissions, which is the result of technological progress and the optimisation of the industrial structure and motivational and limiting mechanisms (Zhang et al., 2023).

Civility/ civilisation aspects

It should be emphasised that research has yet to be found that refers simultaneously directly to the issues of economic culture – civilising aspects and eco-civilisation – energy aspects. The Chinese specificity of moving towards spiritual civilisation indicates references to traditional elements of Chinese culture, defined as moral and ethical. However, the concept of *wenming* seems to be primarily a political concept, similar to that of ‘ecological civilisation’ – a political civilisation. The level of ambition and the focus on the selected priorities of the ‘30-60’ goals announced in 2020, related to achieving peak CO₂ emissions before 2030 and CO₂ neutrality by 2060, is astonishing. Therefore, we can expect new social posters in the near future, focused not only on the vocabulary used and behaviours in line with Chinese etiquette but also on the broader aspect of civilising, i.e., calling for more sustainable behaviour. These prospective patterns would, first of all, reduce energy consumption, encourage investment in alternative energy sources, and reduce CO₂ production. Despite the fact that civilising is currently perceived in threefold ways, over time, it may acquire a purely pro-sustainable character, and a civilised Chinese citizen will become a carbon-free citizen.

Promoting Chinese ecological civilisation, besides sustainable development, is also part of the Chinese strategy of changing China’s position on the world map. Aiming to perceive them as a modern and ecological economy, a significant international partner committed to sustainable development, and an ancient civilisation state that respects and promotes traditional Chinese values (Kuhn, 2019).

Ecological civilisation is sometimes defined as the Chinese system of development and management, which is based on political decision-making (Xue et al., 2023). It is also called a “rhetorical strategy” and a political vision of China’s environmental protection program (Buckley, 2021). Researchers often analyse the actions and effects of this strategy at the macro level. Ensuring the above, future research should focus on the political and cultural dimensions of local policies, both within individual provinces/territories of China and in a broader context – within the countries involved in the Belt and Road Initiative. For example, research conducted by Geng and Lo (2023) shows that the Belt and Road Initiative provides a different interpretation of ecological civilisation than its version in force in the PRC.

Conclusions

This work was conceived as a trailblazing foray into the contemporary economic culture of the PRC, indexed by the socio-pragmatic concept of *wenming*. As part of a larger project (Mazur-Włodarczyk et al., 2024), the subject of the reported research aimed to recognise the specific features of Chinese civilising in the aspects of contemporary interpretation, shaping factors, place in the hierarchy of values and economic activity. Pursuant to those objectives, in the paper, we focused on the concept of *wenming* against the background of the idea of civilising, mapping it against power industry characteristics and the ecological policies of the PRC government. For this stage of the research, the main criterion to align the ecological focus – measurable and reliable – was the data relating to the CO₂ emissions for particular regions. The resulting analytical grid subsumed thus the following parameters: *wenming*, sustainability, ecological, and economic culture. For particular analysis, three variables were adopted: i) CO₂ emissions, ii) population in a given region and iii) GDP in a given region. The original contribution of the project was to carry out a statistical analysis of development factors in individual regions of China and to show their degree of civilisation.

To achieve these research objectives, we have first presented a wide economic and pragmatic milieu for the empirical dimension of the research: structuring of power generation in PRC and measures relating to sustainable, renewable energy solutions as part of the overall Chinese path for growth strategy. We showed how sensitive this aspect is to economic volatility. Next, we addressed termino-

logical quandaries against which the concept of *wenming* should be viewed. We showed how deeply rooted this concept is in Chinese cultural tradition and how intricate its semantic field is. The fact that it relates to nature, civilising, writing, and teaching makes it a viable career in the ecological bent of new Chinese environmental policies. Of particular importance is the fact that *wenming* forms part of twelve cardinal socialist values.

In particular, we focused on the retrospective of the semantic component relating to civilising: instilling good manners and counteracting the bad ones within a society. We also addressed the pivotal role of *wenming* in the process of turning China's industrial civilisation into an ecological civilisation.

Finally, we carried out a statistical analysis of key factors of regional development in China in order to show the most civilised regions and to show the level of modernisation of China's economic structure as a factor of economic productivity growth. First, we showed a breakdown of CO₂ emissions by region. Then, we subjected the gathered data to statistical analysis using the Ward method, which yielded specific dendrograms of the degree of similarity of regions prepared for the target years 1999, 2007, and 2019. While stipulating the need for further and more finegrained research, the stage reported in this paper may contribute to the understanding of the phenomenon of the Chinese economy – showing a different space of economic culture than based solely on the traditional Chinese concepts.

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The contribution of the authors

Conceptualization, K.M.-W.; literature review, K.M.-W.; methodology, K.M.-W. and P.M.; formal analysis, K.M.-W. and P.M.; resources, K.M.-W., J.K.-P. and E.K.; writing, K.M.-W., M.H.-G. and P.M.; conclusions and discussion, K.M.-W.

All authors have read and agreed to the published version of the manuscript.

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CHIŃSKA ENERGIA – ZRÓWNOWAŻONE STRATEGIE

STRESZCZENIE: Artykuł odnosi się do dwóch zagadnień z pola semantycznego pojęcia „wenming” – i) ucywilizowania o cechach chińskich oraz ii) tematyki energii – produkcji CO₂ w Chinach. Jeden z wymiarów koncepcji cywilizowania oraz znaczenia zagadnień zrównoważonej produkcji i konsumpcji w kontekście pogłębiającej się degradacji środowiska nakreślił nasz cel, którym jest przedstawienie relacji między tym, co cywilizowane, a tym, co zrównoważone o chińskiej charakterystyce oraz analiza poziomu zanieczyszczenia CO₂. Efektem powyższego jest próba zgłębienia chińskiego postrzegania ucywilizowania i zidentyfikowania regionów bliższych idei eko-cywilizacji. Do analizy przyjęto trzy zmienne: i) emisje CO₂, ii) ludność w danym regionie oraz iii) PKB w danym regionie. W analizie wyróżniono cztery klastry – grupy regionów wyłaniające się z dendrogramu. Klastry wyodrębnione metodą Warda mogą przyczynić się do bardziej precyzyjnych rozwiązań w walce z emisjami CO₂, do prowadzenia bardziej odpowiedniej polityki związanej z możliwościami i potrzebami produkcji energii ze źródeł odnawialnych.

SŁOWA KLUCZOWE: ucywilizowanie, cywilizacja ekologiczna (eko-cywilizacja), energia, Chiny, zrównoważona konsumpcja i produkcja, kultura ekonomiczna