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Spatiotemporal Profiling and the Need for Energy Commons in Stuart McMillen's *Peak Oil*

Abstract: Intersecting at the crossroads of explainer comic and petronarrative, *Peak Oil* (2015) by Stuart McMillen is a graphic adaptation of how geoscientist Marion King Hubbert developed the peak oil theory. Through its 120 pages of black and grey panels, this graphic narrative narrates human history's transition from coal to oil, oil to peak oil, and the subsequent possible changes the World might face. The present research aims to study how *Peak Oil* represents a necessity for energy commons through the formal elements employed by McMillen. Energy commons, according to Imre Szeman, is an ideology to regulate energy as a vital resource, a deviation from which may turn hazardous to the living communities. In his graphic narrative, McMillen employs various spatiotemporal techniques by placing the character of Hubbert in almost all the pages of the text. This research attempts to study Hubbert's spatiotemporal profiling through Bakhtin's theory of chronotope and Lefèvre's terms for space construction in comics.

Keywords: *spatiotemporal profiling; energy commons; focalization; peak oil; Stuart McMillen; Pascal Lefèvre; postmaterialism; Imre Szeman*; *graphic petronarrative.*

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Introduction

Graphic narratives depicting "oil exploration, extraction, exploitation, the aftermath of the exhaustion,… the peak oil situation and the power politics surrounding the petro-resources" (Ponmani and Narasingaram 274) can be termed graphic petronarratives. In their discourse, graphic petronarratives not only represent "thematic preoccupations: volatile labour relations and ethnic tensions, war and violence, ecological despoliation, and political corruption" (Macdonald 31) but also a vivid urge to re-imagine world-making in sync with the current demographics of oil production and depletion. Subsequently, these graphic petronarratives also serve as mediums for discussing societies concerning energy scarcity owing to lesser access to fossil fuels or alternative energy sources yet to be made affordable for the growing population. 'Energy commons', an idea first propounded by Imre Szeman, tries to address "the problematic lack of attention to energy" (94) and to produce "new insights into the political commitments" (95) in existing discussions of the common. Hence, this paper attempts to study how *Peak Oil* (2015), a graphic petronarrative, depicts a necessity for energy commons through its spatiotemporal dimensions.

Peak Oil as a graphic petronarrative

Peak Oil by Stuart McMillen is a graphic adaptation of Marion King Hubbert's invention of the peak oil theory. First published on his website, stuartmcmillen.com, this comic can be navigated through a horizontal scrollbar, left and right keyboard arrows, and drag-on-screen features. A printed copy with A5 pages of this comic was also published later. However, for ease of availability and to suit the purpose of the paper, the online version is taken into consideration. The comic, in its entirety, is in shades of black, white, and grey, with varying numbers of pages in its digital and print editions. Filled with elongated panels spanning two or more pages for most of the book, McMillen begins the narrative with Hubbert's presence at the American Petroleum Institute meeting in San Antonio, Texas, where he first declared about the decline of the US oil industry. The narrative then shifts to his childhood, narrating his discovery in flashbacks, from his birth in San Saba, Texas, to his education at the University of Chicago, Illinois, to his taking up the course of economic geology. The comic then recounts the development of the steam engine and its immense power that dethroned the sovereignty of muscle mass. With Hubbert's analogy of the coal dependency of modern civilization, the narrative shifts to his summer job at Amerada Petroleum Corporation. Subsequently, the comic builds on the superiority of oil over coal over a few pages, describing the umpteen uses of oil.

The comic's narrative changes with Hubbert's new job at Shell Oil in Houston, Texas, and his research interest in forecasting US oil reserves. The comic explains that during this research, Hubbert developed his theory of peak oil and the bell-shaped curve dealing with oil production, peak, and decline, later known as the Hubbert Curve. This sensational discovery became the keynote address of the 1956 conference with which the

comic began. McMillen adds the peak time, as Hubbert predicted, at this point in the comic. Following this, the comic details the popularity and criticism surrounding Hubbert's discovery during the contemporary time. Hubbert, however, remained unaffected by this validation as he was more concerned with the accuracy of his data. And as fate would have it, his theory turned true in his lifetime during the 1970s. Afterward, he started brooding on a world peak oil phenomenon. Here, the comic refers to the US oil import scenario to declare that once the global peak oil happens, there would be no other place to import oil from, and the alternative energy sources would be either expensive or inaccessible to a large mass that the world would be forced to enhance low-energy-consuming societies. Hence, toward the end, the comic broods on what will happen after peak oil and how the world will respond to it. As *Peak Oil* delves into the subjectivity of oil through and through, it can be safely assumed that it is a graphic petronarrative.

Marion King Hubbert and his legacy

Peak oil, a theoretical concept in the discourses of petroleum depletion, is the apprehension about the end of the most easily attainable oil. In a paper titled "Nuclear Energy and the Fossil Fuels", presented before the Spring meeting of the Southern District, American Petroleum Institute in 1956, Marion King Hubbert predicted the increased oil production, the peak, and subsequent decline of the US oil industry. In his discussion of oil production in the US, Hubbert showed slow oil production in the late 19th century, rapid increase thereafter, peaking between 1965 and 1975 (roughly 2.5 to 3 billion barrels per year), and decline quickly after 2150. To represent this data graphically, Hubbert used a bell-shaped curve, later known as Hubbert Curve. The steepness of the curve after the peak point indicates a rapid decrease in oil production.

After this initial discussion of the US oil production scenario, Hubbert went on to highlight the global peak oil situation. He assumed that the unexploited oil reserves would peak about the year 2000 and decline further and might even disappear in the 22nd century (Hubbert 21-6). Hubbert's prediction posited an apprehension as well as a challenge for the oil production and consumption of masses all over the world. Though scientists are still debating the reliability and truthfulness of Hubbert's predictions, current oil use and abuse figures provide severe underpinnings of oil depletion, thereby confirming Hubbert's prediction.

Space, time and graphic narratives

Graphic narrative consists of "pictorial narratives or expositions in which words (often lettered into the picture area within speech balloons) usually contribute to the meaning of the pictures and vice versa" (Harvey 76). This blend of verbal and visual approaches makes graphic narratives one of the best platforms for multimodal meaning-making. As a visual narrative form, graphic narratives often employ an embodied

approach to consider how characters interact with each other and the world around them, shaping "readers' perception of time, space, and causality" (Kukkonen 49). The time and space inherent in these graphic narratives work on two levels: the narrator's level and the reader's level. Winfried Nöth, in his essay "Time Embodied as Space in Graphic Narratives: A Study in Applied Peircean Semiotics" (2020), calls the narrator's level of space and time as 'visual space and time' and the reader's level of space and time as 'mental space and time.' He also identifies that visual time in a graphic narrative is represented through "lines of writing, its panels, and its pages in their sequential order" (Nöth 300) and mental time through "images of space in live or dead metaphors" (300). On the other hand, mental space, he says, is "the imaginary space in which protagonists experience time in their particular cultural space" (300), and visual space is the space of the movement and action of the protagonist. Nöth also posits that the visual space-time dimension is discontinuous owing to its division of pages into panels separated by gutters and the difference in the size of the panels and the letter sizes (304). At this convergence of continuity and discontinuity of spatiotemporal dimensions, a reader not only generates meaning from the graphic narrative's visual storytelling but also finds traces of a larger implied narrative that the graphic author and illustrator intend to make it to the reader.

In *Understanding Comics* (1993), Scott McCloud asks to "perceive time spatially, for in the world of comics, time and space are one and the same" (100). In other words, McCloud proposes that when one moves in the space of comics, one unintendedly also moves in time. He uses an elongated panel (McCloud 95) and a cut-up panel (97) to convey the understanding that time and space move simultaneously in a comic. While an elongated panel, like a rope, represents several time-space indicators at several points of the rope, a cut-up panel represents time-space indicators either through the insertion of more panels or by increasing the width of the gutter space. Thus, the "[p]anel acts as a sort of general indicator that time or space is being divided" (McCloud 99), (when) duration of time and dimension of space "is defined by the contents of the panel" (99). Owing to McCloud's generalization of time and space and Nöth's visual and mental space, it can be assumed that spatiotemporal understanding is common to every graphic narrative that not only navigates the course of action on the surface of the page but also inside the minds of readers.

In literary discourse, Mikhail Bakhtin first proposed the interconnection between space and time in his "Forms of Time and of the Chronotope in the Novel" (1937-38). In his classification of literary genres, viz. the Greek Romance, Apuleius, and Petronius, ancient biography and autobiography, the chivalric romance, the Rabelaisian Novel, and the idyllic novel he talks about his theory of chronotope:

> We will give the name chronotope (literally, "time space") to the intrinsic connectedness of temporal and spatial relationships that are artistically expressed in literature. This term [space-time] is employed in mathematics and was introduced as part of Einstein's Theory of Relativity… we are borrowing it for literary criticism almost as a metaphor (almost, but not entirely). What counts for us in the

> fact that it expresses the inseparability of space and time (time as the fourth dimension of space). We understand the chronotope as a formally constitutive category of literature. (Bakhtin 86)

For Bakhtin, chronotope comprises the artistic visibility of time and the responsive visibility of space following the movement of time and history. Bakhtinian scholars showcased the uniqueness of chronotope in its non-privileging on either space or time and the inseparability and interdependence of space and time on each other. Since its arrival, chronotope has been used by several scholars in application to fiction, non-fiction, children's literature, language, and culture studies (Johnston 2; Allor 46; Rosa 107; Chakrabarti 79). Since graphic narratives function through "the combination of text and pictures and the arrangement of these elements in the space of the page" (Reumont and Budke 1), the theory of chronotope has also been explored in comics and graphic narratives. Harriet Earle applies Bakhtin's theory of chronotope and Groensteen's theory of Spatio-topia in discussing "the role of the reader and the subsequent manipulation of time in relation to the representation of trauma in comics" (3). Marcelo Mendes de Souza analyses Hernandez's *Luba Comics* (2002), *Chance in Hell* (2007), and *Julio's Day* (2013) to discuss comic-chronotope and the "unfolding of spatial and temporal indicators into an explicit form of historicity" (359). Similarly, Adnan Mahmutović (2018) studies chronotope in Alan Moore and Dave Gibbons's *Watchmen* (1986-87), and Rikke Platz Cortsen (2011) looks into chronotope in *Top 10* (1991–2005) written by Alan Moore and drawn by Gene Ha and Zander Cannon.

Notwithstanding its broad applicability, chronotope is not the only spatiotemporal study attempted by comics and graphic narratives scholars. Comic scholars have conducted various studies focusing on pictorial and verbal representation in the diegetic and extradiegetic space and narrative time. Mike Classon Frangos studies speculative comics for "Anthropocene visualization through their representations of multiple scales of space and time beyond individual human experience" (237). With his fellow researchers from Tilburg University, Netherlands, Neil Cohn has empirically analyzed 134 annotated comics from North America, Europe, and Asia to analyze situational changes between time, characters, and space. Laura Moncion discusses temporal complexity and narrative historiography through time frames and spatial decoding in Richard McGuire's *Here* (2014). Hence, spatiotemporality and comics have a longstanding mutual relation that helps them represent various matters in narrativizing seriousness to the reader.

Spatiotemporality, energy common and *Peak Oil*

Stuart McMillen begins his narrative with Hubbert at the podium for his sensational prediction about the decline of US oil production. The page depicts two democratic panels and a smaller panel with a bell-shaped graph to denote the looming decline of peak oil in the background. While Hubbert's speech is in the present time, the

peak he is talking about is due in 15 years. Alexander Nagel and Christopher S. Wood posit that a work of art not only "points backwards to a remote ancestral origin… or to an origin outside of time, (but also) it points forward to all its future recipients… (as) is a message whose sender and destination are constantly shifting" (9). On a single page, McMillen makes the future time interspersed with the present time. Abiding by McCloud's logic, which suggests the inseparability of space and time in comics, the time stamps McMillen shows also refer to spatial transitions. The subsequent page showing Hubbert's front and back addressing the gathering is also spatially drawn. The point-of-view shots are positioned in overlapping panels; while the large panel depicts Hubbert's back, an inset panel depicts his front. In a way, while the inset panel is the audience's view, the larger panel is the narrator's view. Thus, it is not only a time frame that captures the dual aspects of a particular situation but also an aspect-to-aspect transition, showing simultaneous aspects of the same scene from different perspectives. Since the effect of aspect-aspect transition is to "give the reader a better sense of the space in which the narrative takes place" (Pratt 112), the reader gets an understanding here that though the scene depicts the speech hall of The American Petroleum Institute, it refers to all the other places that might have been or might be sites of discussion of the impending prediction of Hubbert. By doing so, McMillen urges his readers to imagine the peak oil prediction scenario on a global scale. To signify the urgency of the situation and oil monopoly by oil superpowers, even Hubbert's employer, Shell Oil, McMillen, also narrates all the events preceding the startling prediction. The snippets of various events with a time difference of a few seconds or minutes are assembled in panels of varying sizes on the following pages, viz. somebody calling Hubbert from the stage, Hubbert receiving the call from Shell Oil, the executive assistant of Shell Oil urging him not to address the oil scene, Hubbert's anger and disgust with such bigwigs, and his final determination not to pay heed to any such requests. Additionally, there are three kinds of profiling on a single page that show different emotions on Hubbert's face. The left profiling shows his disgust with people's apathy for the energy scenario; the right profiling shows his anger with such a monopolizing attitude, and the middle profiling, a cut-up panel, shows his determination to declare the prediction anyway. Hence, McMillen overpacks the diegetic space, the fictive space of the narration, with information about Hubbert's perception concerning the urgency and necessity of the prediction.

McMillen furthers his narration of energy sources and their usage and limits by discussing animal muscle, coal, and oil. McMillen becomes the omnipresent and omniscient narrator who positions Hubbert at all the turning points of energy transitions of human history to ultimately discuss humans' transition from oil, not after oil but after easily attainable oil (peak oil). With a combination of McMillen's perspective or external focalization and Hubbert's perspective or internal focalization, *Peak Oil* represents spatial as well as temporal knots of humans' energy consumption histogram in verbal and pictorial dimensions. Coincidentally, Hubbert has also been employed in various jobs in the coal and oil industries. Thus, McMillen makes him his spokesperson to ruminate about the "resource and energy requirements of the modern industrial world" (12). In an

elongated panel, McMillen shows the functioning of the steam engine and its high energy capability compared to horse-drawn carriages. The focus is on the limiting power of horse-ridden carts, the "solar-powered locomotives" (16) in contrast to the infinite potential of the steam engine, where "a raging fire burnt in the heart of the iron armour… an inferno which furiously expanded water to steam… away from the horse-drawn carriages" (15). The immense power of coal is shown through bleeding panels, and two inset panels show that the man on the steam engine cannot handle the force of the gushing steam from coal. On the following page, the upper panel provides a spatial representation of plants' transition to coal through fossils, and the lower panel represents the steam engine's power and the sad face of horses to show their inability to compete with the brute force of the steam engine. The comic frame comprising these panels can be termed a time frame because it shows events concerning each other. Additionally, the transition from horse to steam engine is not a single-day change. An article titled "Mechanical Road Carriages: HorseFlesh vs. Steam," published in *The Royal Society* in 1865, evidenced the downfall of horse carriages. Thus, remaining true to the notions of energy commons discussed by Szeman, McMillen represents the limits of animal-drawn-carriages and discusses the "weak potency of grass" (16) as the cause. However, in the ensuing pages, he also apprehends the limiting power of coal and oil using visualized and non-visualized spatial representations.

According to Pascal Lefèvre, visualized space consists of elements that appear inside the frame of a panel, and non-visualized space refers to elements that remain unseen, including virtual supposed space outside the frame of a certain panel and the supposed hidden space within the borders of the panel itself (157-58). McMillen represents Hubbert's concern for the limiting power of coal extraction through such visualized and non-visualized spaces. In a Dutch tilt-angle shot, McMillen makes a spatial representation of the classroom of economic geology class. The panel has a close-up shot of the hands of Hubbert's friend/classmate making paper rockets. The image shows the projectile of a flying paper rocket with the object itself bleeding from the panel. This projectile can be termed a chronotope of the coal production and peak in the panel as it represents not only the world coal production site but also a supposed time when there will be a peak in production. The confined space of the geology class is the visualized space, and its hidden elements, such as the coal production sites, limits of extraction, and subsequent difficulty in coal production, comprise the non-visualized space. According to Lefèvre, extradiegetic space is the "space outside the fictive world of the comic…the material space that surrounds the individual panels; not only the whites between the panels, but also the real space in which the reader is located" (160). McMillen makes a sharp transition from the discussion of coal concern to oil concern in the following frame. The spatial transition from an enclosed classroom at the University of Chicago to the open oilfield of Amerada Petroleum Corporation denotes the implication of the extradiegetic space in the narratorial space of *Peak Oil*. The even white space between these two panels is a part of the diegetic space that suggests Hubbert's movement from the classroom to the oilfield, where a certain time has lapsed. It is also

part of the extradiegetic space that suggests the ensuing discussion of 'energy common' concerning oil. McMillen makes an elongated panel with blurred edges that covers two pages. A single text box describing Hubbert's new job is on the upper left side of the panel, and another text box depicts Hubbert's perception of fossil-fuel-dependent human civilization on the lower right side. The whole panel is a wide-shot image that shows Hubbert's entire background. The oil derricks are drawn slightly bent because this wideshot image represents a massive area in its diegetic space. McMillen has incorporated a spatial confinement technique that shows the vastness of the oilfield in reality as well as the confinement into a small diegetic space of the comic. Through these spatial techniques, McMillen tries to show the vastness of the oil industry, which is constantly mechanized to fulfill the energy requirements of human civilization.

Hubbert's theory of peak oil combines environment, mathematics, and geology. The theory, the datasets associated with it, and its graphical representation are so complex that McMillen goes on for several pages and hundreds of panels to explain it. He employs a spatial code in each frame that helps the reader relate to Hubbert's legacy. Since, according to Henry John Pratt, "panels of comics are juxtaposed in space and not in time" (113), McMillen's explainer panels are spatial codes that represent both the spaces/places where Hubbert came up with his theory and the time stamps which Hubbert predicted and witnessed about peak oil. In a continuous frame that lasts up to six pages, McMillen makes the readers understand Hubbert's bell-shaped curve in the form of instant photos on each page. The first photo-panel represents oil derricks; the second is the bell-shaped curve's tip that is positioned a little above the narrative plain of the first; the third one, a further rise of the curve, is positioned in a way that it overlaps the first and second panels; the upper photo-panel on the next page, a further rise of the curve, and the lower one, a further rise of the curve so that it almost reaches the peak. However, these are not just graphic analyses as they are sufficiently corroborated by McMillen's captions about oil production starting slow and gradually increasing. Thus, here, a pictorial and verbal dimension of narration is intermingled. Another photo panel at the back of all these panels has an image of Hubbert driving his car. The ensuing frames depict two panels with a declining trajectory of the oil extraction. The back panel is not visible except for the final trajectory. The front panel shows the trajectory after the peak. Hence, these panel representations blur the boundaries between mental perceptions and reality. The image shot panels representing the rise of the bell curve is Hubbert's theory, which he is mentally perceiving while driving to the meeting spot. According to Lefèvre, the reader constructs space in a sequence by looking for overlaps and linking the fragments. (159). All the photo-panels of McMillen are fragments of the sequence of peak theory. This fragmentation has not only helped him to explain the complex theory but also helps the reader conceive the importance of gutter and overlaps. On a broader scale, the reader can also perceive the trajectory of oil extraction and the subsequent unavailability, thereby making a recourse for energy common.

Hubbert's theory suggests that the peak curve applies to every well in the world; each oil well in every oil field would follow the same trajectory over a period of time.

Following McCloud, since time can be only seen in terms of space in comics, all the spatial representations of peak curves McMillen makes are also temporal representations (see Fig. 1).

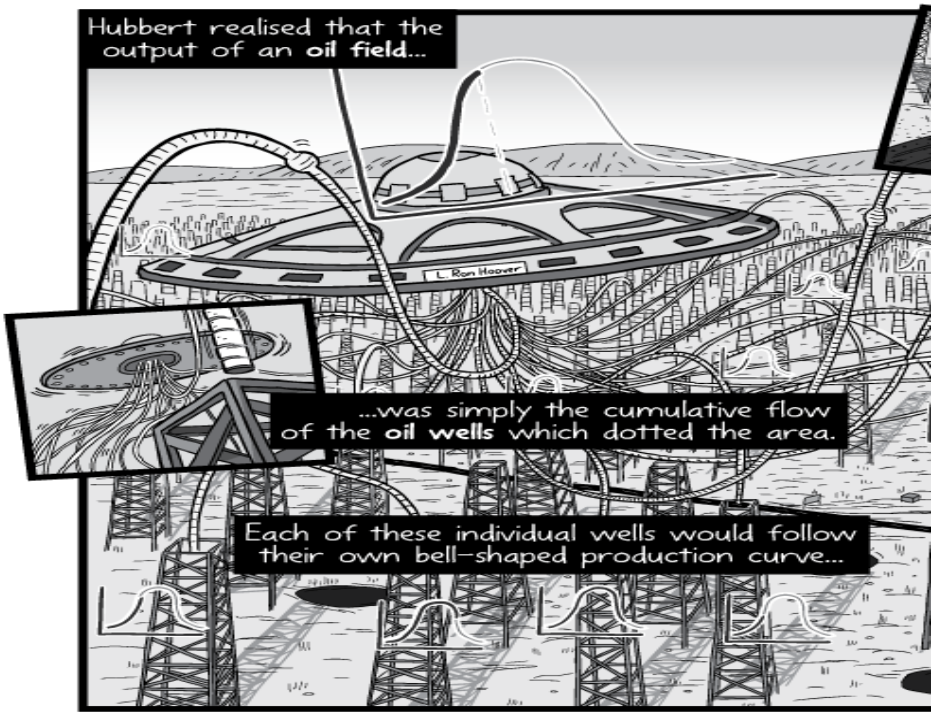

Fig.1. Source: https://www.stuartmcmillen.com/comic/peak-oil/#page-45

At first glance, it is an array of graphical representations of oil derricks with curves sprouting from any end and going onto any end. However, the verbal dimensions of the panel suggest that these are multiple extraction curves of different oil wells in a particular oil field. McMillen has tried to merge different temporal dimensions of oil wells into a single spatial plain. Additionally, the numerous derricks present in a single oil field are represented from a high-angle shot. Hence, some derricks are foregrounded while others are in the background. The derricks in the background are drawn timidly to represent the crowd of derricks. McMillen also shows Hubbert's perception of the finiteness of oil production with a cartographic representation of Pennsylvania. The frame has two panels; while the upper panel is a borderless cartography of Pennsylvania, the lower panel is a compilation of Hubbert's bell curves that would denote the oil production scenario of multiple places in the state and a whole bell curve of the state. The elongated panel also has a zoomed-out image of a globe with derricks on the map of the USA. Multiple arrows

from the derricks are pointed toward an inset panel with a bell curve. A shot of a concerned Hubbert's bust is depicted in a worm's eye view. According to Lefèvre, unexpected elements popping up in later panels previously absent are part of the non-visualized space that an artist achieves through framing techniques (158). The sudden appearance of a globe is one such non-visualized element McMillen employs to discuss the universality of Hubbert's peak theory. Furthermore, with a juxtaposition of different drawing angles, McMillen represented not only a temporal shift in graphs but also a spatial transition in cartography.

McMillen uses the concept of yin-yang to represent a combination of the geological confirmation of finite crude oil and mathematical deduction of the production rate coming to zero (see Fig. 2). In Chinese philosophy, yin-yang is a circle made with the combination of two black and white swirls, with each having a small circle of the other colour. The black swirl, yin represents the negative and feminine force, and the white swirl, yang represents the positive and masculine force. It is believed that yin-yang represents the interaction between two opposite forces to retain balance and order in the system. McMillen shows Yin representing the mathematical curve that would peak with respect to time, and thus the temporal side, and yang representing the geological image of the finite crude reserves, and thus the spatial side. In his discussion of Chronotope, Bakhtin says, "[t]ime and space merge… into an inseparable unity" (49). Since Yin-yang is an inseparable whole, McMillen's representation of spatiotemporality in this panel might be a chronotope of the peak oil theory.

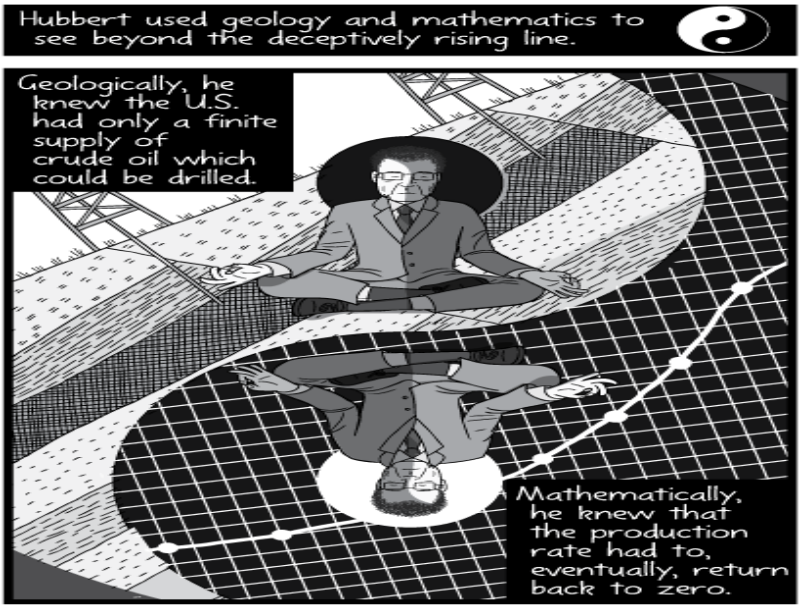

Fig. 2. Source: https://www.stuartmcmillen.com/comic/peak-oil/#page-59

Peak Oil, according to McMillen, is "about creating realistic expectations for the future (and) also about puncturing unrealistic expectations that are impossible in a post-petroleum future" (McMillen 185). He tries to inculcate this combination in his comic by making Hubbert build a roller-coaster out of trusses. With the finite number of drillable oil wells as the number of trusses, McMillen presents Hubbert inside the coaster with its trajectory yet to be completed. While the upper borderless panels represent the high-angle shot of Hubbert with his writing board, the lower panel is a zoomed-out image of him inside the roller coaster. The inset panel in the lower panel of the page depicts half of the peak curve. Perched at the tip of the roller coaster, Hubbert broods on his options for a taller curve with a steeper decline or a flatter curve with a gentler decline; and finally found two points in the time axis, 1966 and 1971, and predicted that US oil would peak between these times. This final revelation is represented in a Dutch tilt angle of a combination of two bell curves with Hubbert's face inside a circular panel at the lower left side of the page. Lefèvre reflects that "spatial relations between figures or objects in a picture can be described by projection systems" (158) and refers to Willats (1997) for two kinds of projection systems, viz. primary geometry and secondary geometry. Primary geometry, a viewer-centered projection, is "The geometry of projection of lines or rays from objects in the scene and their intersection with the picture plane to form an image or picture" (Willats 369), and secondary geometry, object-centered projection, is "The two-dimensional geometry of the picture surface, obtained without recourse to the idea of projection" (369). McMillen incorporates both projection systems in his representation of Hubbert inside the coaster to predict the peak points. The different angles in which Hubbert is brooding the placing of trusses are both viewer-centered, as it makes the reader perceive the finiteness of oil, and object-centered, as it makes Hubbert himself brood on the limits of the trusses and finally come up with a theory. Ultimately, this spatial relation gives a more significant meaning of the finitude of oil to the characters within the comic and its readers.

McMillen represents the popularity of Hubbert's theory in his comic by various framing techniques. These popularity panels also represent the significance of energy justice debates in an era when energy limitation was a distant truth. McMillen shows media houses and economists analyzing it using inappropriate data, and Hubbert discussing it with great precision of data at public events. Szeman, in his discussion of energy commons, says, "[i]t is a way of getting us to ask questions about what we need and why, and to ask which freedoms really are worth struggling for" (101). McMillen's depiction of comprehensive media coverage signifies the similar urgency that Szeman talks of. *Peak Oil* also depicts Hubbert's prediction becoming true in his lifetime when US saw its peak in 1971. An elongated panel represents a spatial plain of Hubbert's discussion; the inset panel shows the temporal plain of his theory becoming true. McMillen also makes eight cut-up vertical rectangular panels of the national flag of the USA flowing in the breeze, all of which mimic the structure of Hubbert's peak curve. A close consideration shows that a tip of the flag is present in the last panel, thus hinting at the "deeper, trickier wells" (McMillen 77) of oil that is hard to extract. These panels and

the positioning of the national flag attune with Lefèvre's proclamation that artists use stereotypical icons to represent a particular space (157). Subsequently, McMillen also shows the transition of energy sources and the difficulty of switching energy sources after oil (see Fig. 3).

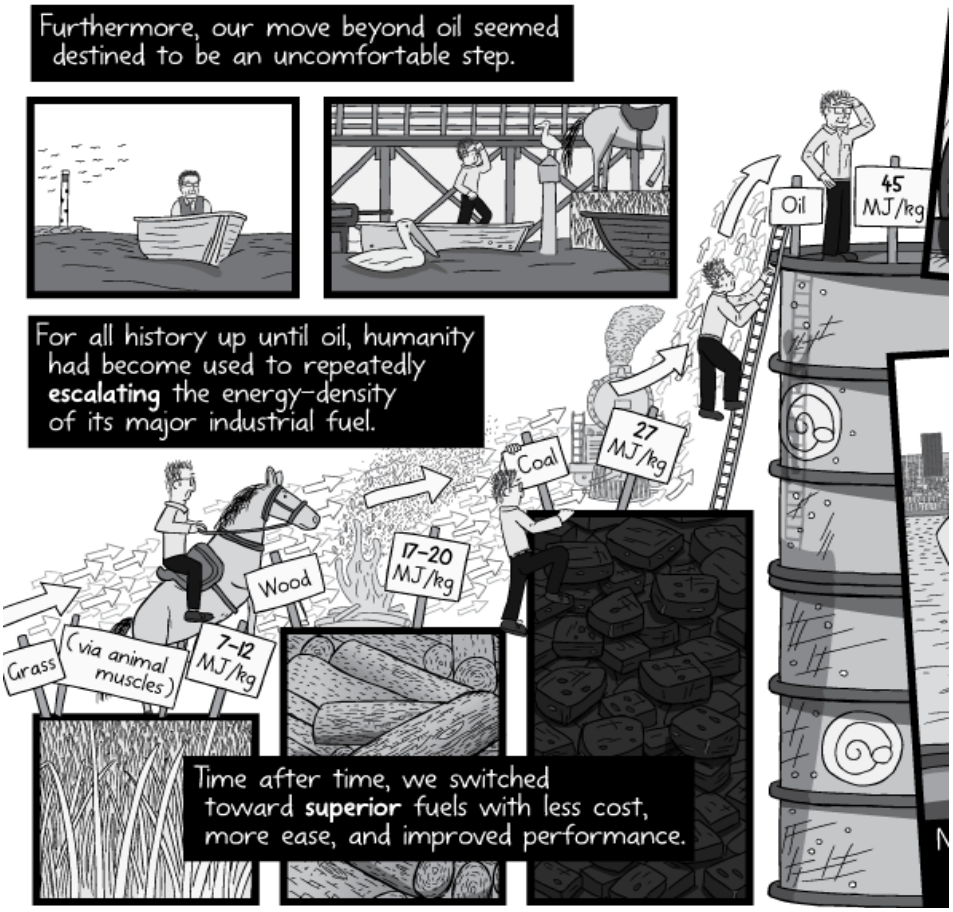

Fig. 3. Source: https://www.stuartmcmillen.com/comic/peak-oil/#page-82

The three lower panels show this transition in the form of an energy source. McMillen uses both pictorial and verbal means to represent this transition; like the rise of the peak curve, the energy sources are depicted diagonally with grass at the lower end and oil at the standard deviation point, after which there is no specific energy source that can match the "cheapness, convenience and grunt" (83) of oil. McMillen makes a zoomed-in image with a point-of-view shot of Hubbert introspecting on all the alternative energy sources, viz. biomass, battery (electric energy), solar panels (solar energy), windmills (wind energy), etc. Thus, the difficulty in using these energy sources makes Hubbert verbally declare the lowering of the energy usage of human civilization. In a single frame,

the upper panel refers to the transition to oil, and the lower panel shows the beyond. The panels refer to a past time in the space of Earth with an abundance of fossil fuels and a future time in the same space of Earth with oil scarcity. Thus, this frame can be a chronotope showing knots in human civilization's time span.

In a frame, McMillen draws Hubbert's point of view in the first panel and Hubbert in the eye-level shot in the lower panel. The first panel shows the various energy requirements of modern human civilization, and the second represents Hubbert's foresight of "social adjustment for humankind" (85). Subsequently, in an elongated frame that lasts up to four pages filled with bleeding panels, McMillen represents Hubbert drawing his curve with the readjustment of the timescale in such a way that it represented 5000 years in the past and 5000 years into the future, consequently making the steep rise and fall of the oil production resemble a monumental pillar. In Hubbert's words and graph, McMillen represents the happenings of 10000 years in a single panel. The graph itself is a spatiotemporal representation of human civilization's burning of oil. In the text box, McMillen's additional verbal dimension reads, "millions of years of accumulated wealth burnt in one brief flare of ancient sunlight quickly fading into the darkness… Once used, forever unobtainable. The whole stockpile gone within a handful of human lifetimes" (88-9). Thus, the elongated frame represents the flashback and an estimated flash-forward of energy usage, thereby making a spatiotemporal profiling of peak oil theory.

In addition to postulating arguments for energy commons, McMillen vouches for an imagination beyond materialism. To do so, he makes Hubbert meditate on our past habits and achievements. Perched at the end point of the half-curve of the coaster, which is also the highest point of fossil fuel use according to the peak curve, Hubbert thinks about the masterly creation of human civilization, viz. the buildings and bungalows and monuments of several cities. McMillen uses Lefèvre's notion of stereotypical icons for spatial representations, viz. an image of the Eiffel Tower for Paris, a structural representation of the Pyramid for Egypt, and numerous other buildings to represent the expansion of manmade structures all over the world. McMillen highlights these materialist creations as bizarre and less useful than fossil fuels. This might be regarded as a chronotope; while the coaster represents the time from the use of oil to its decline, the surrounding image depicts the structures that were built spatially but have survived temporally. In his motif of showing a postmaterialist comic prolepsis, McMillen draws an analogy between the trajectory of the coaster in imagination and reality. A darker black shade coaster with Hubbert represents reality in a single rectangular panel. Above it is a lighter shade coaster representing an unreality, an energy-sufficient society of the bygone era that climate change deniers resort to and, thus, live in denial. The upper image is a temporal unreality that is not going to be true. This combination of a hypothetical and actual coaster movement connotes the materialist and postmaterialist imagination, respectively. By making Hubbert the spokesperson for human civilization, McMillen represents humans' frustration with the loss of oil usage. With the gradual change on Hubbert's face depicting a sense of apprehension by the peak oil to a sense of

compromise, ultimately understanding that we cannot get back in time, McMillen necessitates energy common perspective and the postmaterialist attitude. Here, Hubbert's face is also a site where McMillen makes the temporal transition from peak oil apprehension to peak oil acceptance. Thus, this acceptance is not only spatially but also temporally constructed.

Conclusion

Space and time are two important constituents of any narrative form. Artists and illustrators fall back on these two constituents for narrating the comic's events pictorially and verbally. As an ambassador for making the audience aware of Hubbert's complex peak oil theory, McMillen has incorporated different spatiotemporal profiling techniques throughout his explainer comic. In relation to McCloud's spatial and temporal unification, Henry John Pratt's narrativity in space and time, Mikhail Bakhtin's theory of chronotope, and Pascal Lefèvre's various discussions on space construction in comics, this research has looked into McMillen's focalization, frame and panel construction, gutter width and objects aligning/inclining with it, camera conventions in the panels, varying shapes and positioning angles of the panels, appearance, disappearance, and shading of the objects inside the panel. Ultimately, through analyses of these spatiotemporal techniques, this research has tried to establish that McMillen aims to propagate the necessity of energy commons and postmaterialism. Subsequently, it has been demonstrated that *Peak Oil*, as a graphic petronarrative, connotes the urgency of mindful energy consumption.

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