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Review article

# Climate denial and the classroom: a review

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**Abstract.** Climate change awareness is floundering across the globe despite climate change education being embedded in international treaties to address the climate crisis – the United Nations Framework Convention on Climate Change (the UNFCCC) and the subsequent Paris Agreement. The Intergovernmental Panel on Climate Change (IPCC) acknowledges forces hostile to climate awareness and education – namely, climate denial sponsored by the energy-industrial complex. Climate change is studied by the physical sciences, but climate denial is the purview of the social sciences; the latter has revealed the why and how of climate denial. Climate-denial organizations (which directly deny aspects of the scientific consensus on climate change) and the related petro-pedagogy groups (which teach that oil is a benefactor to humanity, but say little about the connection of fossil fuels to the climate crisis) have arisen to attempt to interfere with the teaching of the science of climate change in school classrooms. These organizations were found in the United States, Canada, and some European nations (this review is mainly restricted to English-language sources). This review aims to (1) provide an overview of climate denial, promoted and funded by the energy-industrial complex; (2) identify and examine organizations involved in climate denial in schools; (3) summarize the strategies of climate-denial organizations in school classrooms; and (4) put forward recommendations for further research and action.

## 1 Introduction

Recent surveys of public knowledge of the consensus on the science of climate change reflect the state of climate change awareness and climate change education that they learned during their school days. Polls indicate that, in nations around the world, the public audiences have a poor understanding of the science of climate change despite climate education being an article in the international treaty on climate change (the UNFCCC 1992, Art. 6) and the Intergovernmental Panel on Climate Change (IPCC) acknowledging the importance of climate education. Several studies have identified the issues that confront climate education (see, for example, Monroe et al., 2019; Rousell and Cutter-Mackenzie-Knowles, 2020; Coon et al., 2024), but climate denial is an external force blunting the acceptance by the public audiences of the science of climate change and distorting the objectivity of policymakers and legislators (Kutney, 2024).

Science denial has often been driven by religious and/or political ideology, although climate denial was primarily driven by corporate profits. Corporate-driven science denial became more commonplace after World War II as health and environmental sciences emerged, raising political pressure against offending industries. An early famous example of corporate-driven science denial was by the tobacco industry (Oreskes and Conway, 2010, Chap. 1). With the science of climate change, the perpetrator of propaganda was the energy-industrial complex (Gelbspan, 1995, 1997; McCright and Dunlap, 2000, 2010; Oreskes and Conway, 2010, Chap. 6; Dunlap and McCright, 2015; IPCC, 2022b, pp. 1377–1378; McKie, 2023; Vowles, 2024; Kutney, 2024, Chap. 5; Brulle et al., 2024).

Opposition to climate denial generally has arisen but is only briefly mentioned in this review. Popular examples of challenging climate denial include those by Climate Feedback (2024), Cranky Uncle (Cook, 2024a; see Fig. 1), DeSmog (2024a), friends of #ClimateBrawl (Kutney, 2024, pp. 25–27), Global Weirding (Hayhoe, 2024), National Center for Science Education (see below), and Skeptical Science (Cook, 2024b); by the scientists John Cook, Andrew Dessler, Katharine Hayhoe, Peter Kalmus, and Michael E. Mann;

and by notable news coverage in *Canada's National Observer* and *The Guardian*, among others. A special mention must also be given to Adam McKay for their Academy Award-nominated political satire on climate denial *Don't Look Up* (Netflix, 2021). Nevertheless, despite such efforts to stop it, climate denial and the propaganda funded by the energy-industrial complex have continued, especially in the United States (Eaton and Day, 2019; Coan et al., 2021; Lewandowsky, 2021, p. 6; IPCC, 2022a, pp. 1939–1940, p. 1982; McKie, 2022, 2023; Vowles, 2024; Kutney, 2024, Chap. 5). A recent review study titled "Counteracting climate denial: A systematic review" concluded the following:

> Evidently, this review shows that no advice can be given on how to universally counteract climate denial … As mitigation efforts continue to advance, it is important to understand how to gain enhanced public acceptance. Counteracting denial is critical in that endeavour. (Mendy et al., 2024, p. 516)

This countermovement to the science of climate change is widespread; a case in point is the public viewing on the preprint of this paper on the European Geosciences Union (EGU) interactive community platform (EGUsphere), where the manuscript received over 1500 views. Several comments were made from two sources, and both generally reflected climate denial; for example, the initial comment included the following:

- Global warming is no threat to human health and no threat to food security. Claims of the contrary have no support from facts and serious science.

- It is apparent that the deniers are those that claim that there is a climate crisis. They are denying facts and climate science (CC1, 2024).

The intrusion of the energy-industrial complex into schools is not new to the United States; the history of the industry-funded propaganda aimed at kids has been traced back to 1928 but escalated in the 1950s (Westervelt, 2023; see also Zou, 2017; Climate Town, 2023). For recent reports in America, for example, where the largest number of climate-denial organizations in schools were found, see Atkin (2020), Climate Town (2023), Damico and Baildon (2022), Noor and Westervelt (2023), Reid and Branch (2023), Strauss (2017), Waldman (2023a, b, c), Worth (2021a), and Zou (2017).

Climate denial in the classroom is the focus of this review, which provides a summary of the climate-denial organizations that are the leading offenders in manipulating climate education in schools. The goal of this review is to create awareness of the growing climate-denial threat in school classrooms to promote climate education and help educators with addressing anti-science influences of climate denial.

## 2 Method

A chief task of climate communication is the teaching of the main messages of the science of climate change to the public audiences and in all levels of education. This review focuses on the most vulnerable sector among the general population, the children in primary and secondary levels (K-12 in North America), of education.

Over 200 articles were reviewed, of which 25 % were from peer-reviewed journals, IPCC reports, and books from the academic press; the remainder were from grey literature, including news media, polling data reports, online science/climate news magazines, and websites (especially from climate-denial organizations). References in the peer-reviewed literature were sought on the influence of climate-denial organizations and/or the fossil fuel industry in schools, especially those recently published (since 2021), with selected earlier references. A major purpose of this review was to illustrate the scope of such organizations involved in climate denial in the classroom. Grey literature sources were added for quotes, critical commentary, and up-to-date news media information. Websites for organizations associated with climate education and those for groups promoting climate denial in schools have also been utilized. Generally, the peer-reviewed literature was found using Google Scholar and the grey literature using Google; specific searches included "petro-pedagogy"; "climate denial, schools"; "fossil fuel industry, schools"; and "petroleum industry, schools" and the names of particular climate-denial organizations in schools listed in this review. Studies picked up by these searches were also examined for other relevant references. Mainly references in the English language were examined.

The term "climate denial" is defined as "those who deny the accepted science that greenhouse gas emissions must be stopped as soon as possible, as climate change is a present-day threat, is getting worse, and is mainly caused by us" (Kutney 2024, p. 17) and also includes teaching about the fossil fuel industry, but neglecting that the burning of fossil fuels is the main contributor to the creation of climate change (which is especially relevant to petro-pedagogy). Climate change denial is abbreviated in this review to climate denial, as are related terms such as climate change communication to climate communication and climate change education to climate education.

This review sets out to answer a series of questions as follows:

- What is the current state of public knowledge of the science of climate change?

- What are the barriers to gaining knowledge about the science of climate change, and how do they affect the school systems?

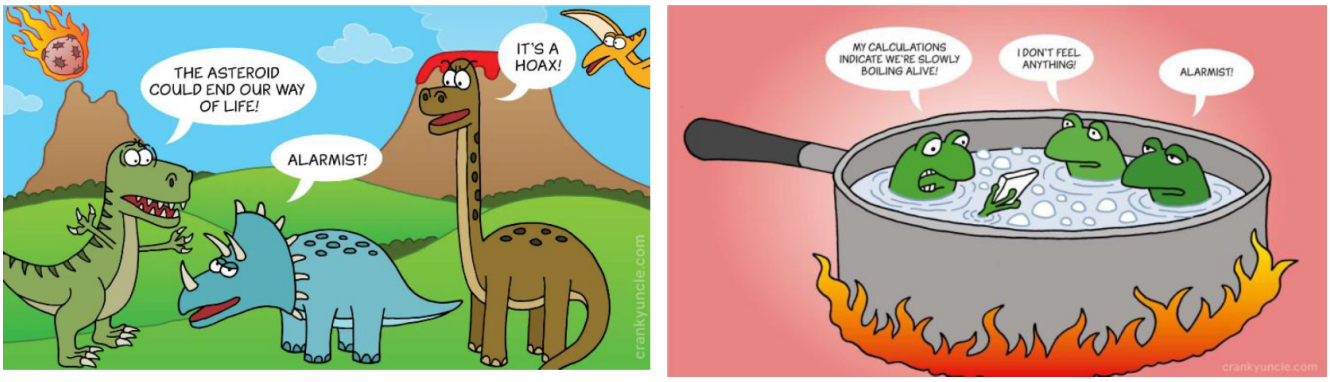


**Figure 1.** The figure has been included with permission of John Cook (https://crankyuncle.com, last access: 27 October 2023).

– What organizations are attempting to hinder climate education in schools? What strategies are they using to influence climate education in schools?

In the last section (Discussion), conclusions, recommendations, and suggestions for future research are offered. These are based mainly on the findings presented in the Results section and also my decade-long experience challenging climate denial on Twitter (now X) and the research for my book *Climate Denial in American Politics: #ClimateBrawl* (Kutney, 2024).

## 3 Results

### 3.1 The state of climate knowledge and education

Recent surveys (since 2020) have revealed an alarming lack of understanding of the science of climate change by the public audiences (Pasquini and Kennedy, 2023; Leiserowitz et al., 2023a, c, d; Tyson and Kennedy, 2023; Tyson et al., 2023; Energy Policy Institute at the University of Chicago, 2023; Alvarez et al., 2023; Eichhorn et al., 2020; Verner et al., 2023). The polls are presented in order of the geographical scope of the survey, beginning with one country (the United States) and ending with a survey of most countries of the world. The polls often ask a series of questions; only the most relevant one to the consensus view of the science of climate change by the public audiences is discussed below. According to the IPCC, an important aspect of this consensus is that "Human activities, principally through emissions of greenhouse gases, have unequivocally caused global warming" (IPCC, 2023, p. 4).

A survey ($N = 8842$) was conducted by the Pew Research Center on how Americans viewed the understanding of climate change by climate scientists (Pasquini and Kennedy, 2023). Those who responded that climate scientists understood "very well" the causes of climate change were disturbingly low and not improving over time: 28 % in 2016 and 24 % in 2023. A major divide was found by political orientation: 7 % of Republicans replied that climate scientists understood the causes of climate change very well; only 41 % of Democrats had also replied with very well. A more basic question in the poll was whether climate change was occurring; here the results of the understanding of the climate scientists being "very well" were only marginally better, at 33 % in 2016 and 32 % on 2023. The authors of the study noted the following:

> Democrats with more education rate climate scientists' understanding higher than Democrats with less education. But how Republicans rate scientists' understanding of aspects of climate change does not differ by education level. (Pasquini and Kennedy, 2023)

The IPCC assessments, for example, demonstrate that the climate scientists know very well that climate change is occurring and its causes (IPCC, 2023, p. 4); the Pew survey shows that less than half of Americans are aware of this pivotal point of the scientific consensus on climate change.

Interviews (with 32 adults) were also held by the Pew Research Center with Americans "most sceptical about climate change". (The purpose of this question was to find out why some Americans did not see an urgency to deal with climate change, while scientists were calling for immediate action.) The replies from "those most sceptical about climate change" provided their personal reasons for their climate denial:

– natural cycles caused climate change,

– climate scientists have an agenda,

– government legislation should not restrict individual freedoms (Pasquini et al., 2023).

A noted survey on climate change attitudes among Americans by the Yale Program on Climate Change Communication has been ongoing for several years. The Yale survey ($N = 1085$) breaks down replies into "Global Warming's Six Americas" (values in brackets are the results of the poll taken in December 2022):

1. alarmed – convinced that global warming is happening and is human-caused and strongly support climate action (26 %),
2. concerned – convinced that global warming is happening and is human-caused but are less motivated to take action (27 %),
3. cautious – do not know whether global warming is happening and human-caused (17 %),
4. disengaged – unaware of global warming (7 %),
5. doubtful – question whether global warming is happening or human-caused (11 %),
6. dismissive – reject that global warming is happening and human-caused (11 %).

The alarmed and concerned categories match best the consensus on the science of climate change. Over the past decade, the share of respondents in the alarmed and concerned categories have significantly increased (38 % to 53 %; and the cautious category has been reduced by a comparable amount). The total for the last three categories combined has remained steady near 30 % for 10 years (Leiserowitz et al., 2023a; see also Leiserowitz et al., 2023d). The Yale group has also carried out a global survey using the same categories; this is presented later.

The Yale survey above had 53 % of those surveyed (in the alarmed and concerned categories) agreeing that climate change was caused by human activity. The Pew Research Center also conducted a poll ($N = 8842$) on public awareness of climate change in the fall of 2023. Only 46 % replied that a "great deal" of human activity contributed to climate change, 19 % among Republicans and 71 % among Democrats (Tyson and Kennedy, 2023; see also Tyson et al., 2023 ($N = 10\,329$), Energy Policy Institute at the University of Chicago, 2023 ($N = ?$), and Alvarez et al., 2023 ($N = 2096$)). Only about half of Americans in this group of polls were aware that modern climate change was caused by us despite the fact that this is "unequivocal" according to the IPCC in their latest assessment of the science of climate change (IPCC, 2023, p. 4).

A survey ($N = 10\,233$) of several European countries and the United States found similar results, and the conclusion was

> We therefore advise climate change communicators, activists, and scientists to focus first and foremost on challenging the common misconception that scientists are somehow divided on the anthropogenic causes of global warming, and on closing the gap between the public and scientific consensus on climate change. In addition, specific efforts to address impact scepticism [those who believe that global warming is harmless or even beneficial] are necessary. (Eichhorn et al., 2020, p. 44, see also p. 45)

The broadest survey ($N = 108\,946$ on Facebook) of most countries of the world (no data were available from China, Russia, and Iran) has been undertaken by the Yale Program on Climate Change Communication (see above) and Meta in two reports. Using the same categories as for their American surveys, countries in the alarmed and concerned categories ranged considerably; on the high end was Mexico at 88 %, and at the low end was Norway at 42 % (Verner et al., 2023). Any category below alarmed and concerned indicates some degree of climate denial, with the most extreme climate deniers found in the category of dismissive (only the United States yielded a result greater than 10 % in this category). In the second report by the Yale Program on Climate Change Communication and Meta, representing 187 countries ($N = 139\,136$ on Facebook), the majority of participants in only 16 countries agreed that climate change is "mostly caused by human activities" (Leiserowitz et al., 2023c, p. 8, pp. 30–35; see also Readfearn, 2024).

What do the above surveys generally illustrate? Despite decades of evidence producing a scientific consensus that modern climate change is human-caused, which has been affirmed by the high-profile, global assessments of the peer-reviewed literature by the IPCC (2023, p. 4, p. 24), polls have found that many people, especially in the United States, are ignorant of the irrefutable messages of the science of modern climate change and the scientific consensus. This "consensus gap" (Skeptical Science, 2024) between the public audiences and science impedes policy development on the climate crisis. Until the public audiences accept the basic tenets of the science of modern climate change, legislation to address the climate crisis is unlikely, if not impossible. This problem will fall more on the next generation to resolve, and thus their climate education is more important than ever before.

Generally, these surveys reflect climate education when those surveyed were still at school and/or more recent post-education influences on their knowledge of the science of climate change. The youth now in school will need to be better educated than those in these surveys for progress against the climate crisis to take place.

### 3.2 The UNFCCC and IPCC on climate education

Under the United Nations Framework Convention on Climate Change" (UNFCCC, 1992, Art. 6; see also the Kyoto Protocol (UNFCCC, 1998, Art. 10e) and the Paris Agreement (UNFCCC, 2015, Art. 12)), 198 countries are obligated to develop climate education programmes. Recently, the UNFCCC has reiterated its importance:

> Climate change education is one central foundation to achieve the goals of the Paris Climate Change Agreement. It can provide everyone – children, youth and adults… Education about climate

> change, above all for young people, is presently sorely lacking on a global scale. (UNFCCC, 2023; see also 2022)

At the United Nations Climate Change Conference (COP28), the Declaration on Education and Climate Change was signed by 39 countries; Stefania Giannini, the United Nations Educational, Scientific and Cultural Organization (UNESCO) assistant director-general for Education, declared the following:

> We all recognize that the most effective way to halt the further advancement of climate change is to empower teachers and learners with the knowledge, skills, attitudes, and behaviours necessary for impactful action. (UNESCO, 2024)

A poll by UNESCO of 100 countries on integrating climate education into their curriculum introduced its study by stating, "This document begins with the assumption that education is essential to prepare societies to address the climate crisis … there is a need to understand the depth of inclusion of climate change education within national curriculum frameworks" (UNESCO, 2021, p. 4). The UNESCO survey results indicated that most countries were not meeting their international treaty obligations on climate education; the overall finding was that 93 % of countries had no or a very minimal level of content on climate change in their national curriculum (UNESCO, 2021, p. 12). Another UNESCO study found the following:

> The quality of the current climate change education is in question. Seventy per cent of the youth surveyed say that they cannot explain climate change, or can only explain its broad principles, or do not know anything about it, putting into question the quality of climate change education in our schools today. (UNESCO, 2022a, p. 3)

Another article of the UNFCCC states that the Intergovernmental Panel on Climate Change (IPCC) will provide "objective scientific and technical advice" (UNFCCC, 1992, Art. 21.2). The IPCC presents the consensus view of the recent science of climate change in their assessment reports (Oreskes, 2004), and a special aspect of the IPCC assessment process on the scientific consensus is the approval of the reports by global governments (IPCC, 2021). The science of climate change is the most scrutinized science in history because of the IPCC assessments (and others):

> The IPCC's task was to produce a comprehensive review and recommendations, which it has now done six times over 35 years. In terms of scale and significance, it may be the most important scientific endeavour in human history.
>
> The IPCC experts are, in short, the most informed people on the planet on climate. (Carrington, 2024b)

Considering the scientific consensus and the robust nature of the science, it is therefore all the more puzzling that climate communication has not been more successful. Psychologist Dan Kahan bluntly described the frustrating problem: "The failure of widely accessible, compelling science to quiet persistent cultural controversy over the basic facts of climate change is the most spectacular science communication failure of our day" (Kahan, 2015, p. 2; see also Cologna et al., 2024).

In the latest reports of the IPCC (AR6), two statements on climate education survived the gruelling approval process in the Summary for Policymakers (SPM) (i.e., only the most salient points appear in the SPM); first, in *Impacts, Adaptation and Vulnerability*, the following is stated:

> Enhancing knowledge on risks, impacts, and their consequences, and available adaptation options promotes societal and policy responses … sources can deepen climate knowledge and sharing, including capacity building at all scales, educational and information programmes. (IPCC, 2022a, p. 28)

The second statement is found in the important *Synthesis Report*:

> Increasing education including capacity building, climate literacy, and information provided through climate services and community approaches can facilitate heightened risk perception and accelerate behavioural changes and planning. (IPCC, 2023, p. 30; see also p. 107)

The IPCC has also acknowledged a hostile countermovement against the science of climate change through a variety of related terms mentioned in the AR6:

- climate denial (IPCC, 2022b, p. 185, p. 469, p. 526, p. 1737),
- scepticism (IPCC, 2022b, p. 469, p. 524, p. 555, p. 1374, p. 1377, p. 1737),
- climate change countermovement (IPCC, 2022b, p. 58, p. 127, p. 557, p. 1358, p. 1377),
- contrarian (IPCC, 2022a, p. 1940),
- misinformation/disinformation (IPCC, 2022a, p. 954, p. 1931, p. 1939, p. 1940, p. 1982, p. 2712, 2022b, p. 58, p. 1377, p. 1411).

These terms are all associated with climate denial (for example, see Kutney, 2024, Chap. 1).

In the technical summary of "Climate Change 2022 – Mitigation of Climate Change", the pernicious effect of climate denial on climate education is clearly presented: "Accurate transference of the climate science has been undermined significantly by climate change counter-movements

… through misinformation" (IPCC, 2022b, p. 58; see also p. 1377, 2022a, p. 1931, p. 1939, p. 1940). A similar warning appeared in the *Synthesis Report*: "organized counter movements have impeded climate action, exacerbating helplessness and disinformation and fuelling polarization, with negative implications for climate action" (IPCC, 2023, p. 52). In summary, the AR6 reports of the IPCC acknowledge how climate communications, awareness, and action have been adversely impacted by the constant propaganda of climate denial that has deceived the public audiences.

The IPCC has also briefly reported on the involvement of the oil industry (and other members of the energy-industrial complex) in these climate-denial campaigns:

> Vested interests have generated rhetoric and misinformation that undermines climate science and disregards risk and urgency … Resultant public misperception of climate risks and polarized public support for climate actions is delaying urgent adaptation planning and implementation. (IPCC, 2022a, p. 1931)

They also report that "the oil industry has underpinned emergence of climate scepticism" (IPCC, 2022b, p. 1374).

Yet, the president-designate of the COP28 of the UNFCCC in the United Arab Emirates was the chief executive of the Abu Dhabi National Oil Company who caused much outrage with their comments "verging on climate denial" (Carrington, 2023), and an ex-oil executive, Mukhtar Babayev, has been appointed the president-designate for COP29 in Azerbaijan (Gayle, 2024).

### 3.3 Climate denial as a hindering factor

The first major exposé on climate denial appeared in the mid-1990s by the journalist Ross Gelbspan. They described the disinformation campaigns by the energy-industrial complex (fossil fuel and related industries) to cast doubt on the science of climate change in the news media and government hearings (Gelbspan, 1995, 1997). A decade later, another investigative report appeared on Canadian TV, on the CBC public affairs programme *The Fifth Estate*. The "denial machine" revealed how the energy-industrial complex followed the tobacco strategy and financed the denial machine, including contrarian scientists and PR firms to dupe the public audiences into thinking that a debate still existed about the science of climate change. (The original broadcast does not exist online, and requests to CBC went unanswered; see Government Accountability Project, 2006.) A year later, the denial machine was back in the news in an article in *Newsweek* titled "Global Warming Deniers Well Funded". The article described how the denial machine was framing public opinion and killing climate bills in Congress through propaganda by contrarian scientists, right-wing think tanks, and industry creating a "paralysing fog of doubt around climate change" (Newsweek Staff, 2007).

A masterful study on anti-science propaganda by corporations appeared in 2010 – *The Merchants of Doubt*. The first chapter of the book by historians Naomi Oreskes and Erik Conway was called "Doubt is Our Product" (Oreskes and Conway, 2010, Chap. 1). Here, the authors presented the disinformation campaigns of the tobacco industry and then gave similar accounts of events in other industries. Many of the major science denial actors for tobacco were hired by the energy-industrial complex, including the same right-wing think tanks and contrarian experts (Oreskes and Conway, 2010, Chap. 6). No connection exists between the science of smoking causing cancer and the burning of fossil fuels causing climate change, but knowledge of the science was not what mattered; the main job requirements were being good at propaganda and denying science.

A blunt warning about climate denial from the energy-industrial complex came from an initiative led by the United Nations Development Programme (UNDP) and the government of Italy, Youth4Climate:

> Recalling that fossil fuel companies have exercised huge power, influence and wealth, in order to intentionally spread lies, doubt and disinformation about the climate crisis for decades. This has led to widespread climate denial and "scepticism" in media and society as a whole, for the sole purpose of safeguarding the profits of their industry. (Youth4Climate, 2022, p. 24)

A *Guardian* survey from 2024 of the world's top climate scientists ($N = 380$) on why we were not tackling the climate crisis found the following:

> The capture of politicians and the media by vastly wealthy fossil fuel companies and petrostates, whose oil, gas and coal are the root cause of the climate crisis … Disinformation was a major concern for scientists from Brazil to Ukraine. This was polarizing society, compounding a poor public understanding of climate risk and blinding people to the fact almost all the climate solutions needed were at hand. (Carrington, 2024b)

And in a companion article on the *Guardian* survey, the following statement was made: "A lack of political will was cited by almost three-quarters of the respondents, while 60 % also blamed vested corporate interests, such as the fossil fuel industry" (Carrington, 2024a). Lisa Schipper of the University of Bonn was quoted in the article: "My only source of hope is the fact that, as an educator, I can see the next generation being so smart and understanding the politics".

### 3.3.1 The science of climate denial

The science of climate change is essentially a physical science, but the study of climate denial is a subject for the social sciences. Individual denial of the science of climate change is more a topic for psychologists who deal with climate denial, whereas collective denial of the science of climate change is explored more by sociologists who study the "climate change countermovement" or "climate denialism". A brief overview of both sciences is presented below.

### 3.3.2 Psychological study of climate denial

An early report specifically on the psychology of climate denial appeared in 2001. The study examined "socio-psychological denial mechanisms". The authors found that "The most powerful zone for denial was the perceived unwillingness to abandon what appeared as personal comfort and lifestyle-selected consumption and behaviour in the name of climate change mitigation" (Stoll-Kleemann et al., 2001, p. 113). In a second study 2 decades later, a dichotomy arose. The majority accepted the serious nature of climate change and supported "mitigation in the abstract" but were still not doing much individually, waiting for others to act first (Stoll-Kleemann and O'Riordan, 2020, p. 12; see also Bushell et al., 2017; Wullenkord and Reese, 2021; Berkebile-Weinberg et al., 2024).

Several cognitive biases in climate denial (attentional, perceptual, recall, confirmation, present, status quo, pseudo inefficiency, and single action) and ways of overcoming them have been reviewed (Zhao and Luo, 2021). Psychologists have found that prebunking ("first, an explicit warning of an impending disinformation attempt and, second, a refutation of an anticipated argument that exposes its fallacy") is more effective than debunking in the case of the climate propaganda (Lewandowsky, 2021, pp. 11–12; see also Lewandowsky et al., 2020).

In November 2022, a collaborative publication between the journals *Nature Human Behaviour* and *Nature Climate Change* was called "Climate change and human behaviour" (Antusch and Yan, 2022). In this series, an article titled "A toolkit for understanding and addressing climate scepticism" by Hornsey and Lewandowsky (2022) examined the psychological origins of climate denial and how to challenge it (see also Wong-Parodi and Feygina, 2020; Ekberg et al., 2023). The abstract for the paper began with the following:

> Despite over 50 years of messaging about the reality of human-caused climate change, substantial portions of the population remain sceptical. Furthermore, many sceptics remain unmoved by standard science communication strategies, such as myth busting and evidence building. To understand this, we examine psychological and structural reasons why climate change misinformation is prevalent. (Hornsey and Lewandowsky, 2022)

They examined the interplay between personal and organized drivers of climate denial in Europe and on a global scale. In Europe, the denial machine was delaying action to stop climate change. The following strategies were presented for reducing the damage of climate denial:

1. "appealing to sceptics through value-based frames",
2. "appealing to sceptics through co-benefits",
3. "leveraging climate-friendly actors within the conservative movement",
4. "establishing norms",
5. "consensus messaging",
6. "embedding climate-friendly actions in social practice" (Hornsey and Lewandowsky, 2022).

For the degree of climate denial outside of America, see also Dunlap and McCright (2015, pp. 318–320), McCright (2016, pp. 79–82), Eichhorn et al. (2020, p. 16, p. 45), Nartova-Bochaver et al. (2022), McKie (2022, 2023), Berkebile-Weinberg et al. (2024), Vowles (2024), and Brulle et al. (2024).

Also, in this special *Nature* issue, an article by Jenny and Betsch was titled "Large-scale behavioural data are key to climate policy", where they explained that "improving individual knowledge through better communication alone is insufficient" (Jenny and Betsch, 2022, p. 1444) and that industries must be targeted to deal with the climate crisis. Their main message was that not enough attention was being paid to behaviour science and concluded the following:

> In addition to the structures that allow data collection, we urge governments to install structures that foster exchanges between scientists, politicians and the administrations to finally facilitate the actual use of behavioural evidence. (Jenny and Betsch, 2022, p. 1447)

Barriers stand in the way of public knowledge about climate change, including climate denial, which is serving vested interests, such as hard-line conservatives and the energy-industrial complex (Oreskes and Conway, 2010, Chap. 6; McCright and Dunlap, 2011; Dunlap and McCright, 2015; Hornsey et al., 2018; Lewandowsky, 2021; Hornsey and Lewandowsky, 2022; Kutney, 2024; Brulle et al., 2024). Stephan Lewandowsky has warned that "These political implications have created an environment of rhetorical adversity in which disinformation abounds, thus compounding the challenges for climate communicators" (Lewandowsky, 2021, p. 1) and that "The terrain for climate communications is treacherous" (Lewandowsky, 2021, p. 8) because of the adversarial environment created by climate denial. Stoetzer and Zimmermann reached similar conclusions:

> If protecting one's [political] group identity outweighs other motives, then from a policy perspective, reducing the existing misperceptions will be a difficult task. The key challenge would be to change group identities or weaken them altogether, which seems uncharted territory for policymakers. (Stoetzer and Zimmermann, 2024)

In the introduction to the paper "The differential impact of climate interventions along the political divide in 60 countries", the researchers stated the following:

> [S]cientific consensus messaging (i.e., informing the public that most scientists are in agreement about the climate crisis) has had limited effects on climate sceptics' support for climate action, or has even sparked reactance and decreased support for climate policy. (Berkebile-Weinberg et al., 2024)

The climate-denial wall stands high and strong, hindering climate communications, knowledge building on the science of climate change, and climate education.

#### 3.3.3 Sociological study of climate denial

By the turn of the millennium, sociologists had found climate denial to be a social countermovement (McCright and Dunlap, 2000). The fear held by conservatives is not the existential threat from climate change but from a perceived threat to the world view of conservatives and their traditional American values, especially their interpretations of individual freedom and free enterprise (McCright and Dunlap, 2000, pp. 504–505). McCright and Dunlap studied over 200 climate-denial reports from 30 right-wing think tanks between 1990 and 1997 (notably, most of the reports appeared in 1997, the year of Kyoto Protocol). Two arguments were present in more than half of the think tank reports: the science of climate change is highly uncertain (63 %), and climate change policies would harm the national economy (58 %) (McCright and Dunlap, 2000, pp. 510–518). In 2010, McCright and Dunlap reviewed again the opposition of conservatives to environmental issues as a countermovement to defend the "industrialist social order" (McCright and Dunlap, 2010, p. 104). Later, McCright wrote that "the climate change denial countermovement as a collective force defending the industrial capitalist system" (McCright, 2016, p. 77; see also Brulle, 2014; Dunlap and McCright, 2015). Recently, Ruth McKie concluded:

> The USA was the birthplace of the organized opposition that emerged to challenge environmental legislation and climate action. Its roots stemmed from the purposeful consolidation of an action plan by the fossil fuel industry and vested interests … If it were not for this organized campaign, countermovement opposition organizations across other countries may not have had the opportunity to emerge and garner success. (McKie, 2023, p. 43)

In summary, public opinion surveys, investigative reports, and social science studies support the premise that climate communication is under siege by a powerful foe – climate denial, which is antithetical to climate education. Are schools directly being targeted by climate-denial organizations?

#### 3.3.4 Climate denial in the classroom

Climate denial in the classroom includes petro-pedagogy. The term has been used to describe the energy-industrial complex funding energy and climate education programmes for K-12 education, especially in STEM (science, technology, engineering, and mathematics) education (Eaton and Day, 2019, p. 462). A general relationship has unfolded:

non-profit education programmes + energy-industrial complex sponsorship = petro-pedagogy.

Beware of the energy-industrial complex bearing gifts. Petro-pedagogy is a Trojan Horse with climate denial stealthily hidden within and brought into the classroom, attempting to convert children and teachers into fossil fuel enthusiasts. Petro-pedagogy teaches that oil is a benefactor to humanity and that modern civilization cannot exist without fossil fuels, but says little, if anything at all, about the connection of fossil fuels to the climate crisis (Eaton and Day, 2019; Tannock, 2020). This newer expression of climate denial is one also used by "oil apologists" who laud fossil fuels by exaggerating how indispensable their contribution is to society yet are silent on their negative impact on the climate; this is climate denial by omission (Kutney, 2022).

A synopsis on the climate-denial organizations and petro-pedagogy organizations promoting climate-denial in the classroom is presented below (see Fig. 2 for editorial cartoons reflecting conservative climate denial views and liberal views of petro-pedagogy). While many groups have attempted to influence climate education in primary and secondary schools, the impact of these climate-denial organizations requires further research (some of the organizations do provide statistics on the number of teachers, for example, that have taken their educational programmes).

### 3.4 Organizations attempting to hinder climate education

#### 3.4.1 Global

##### Energy4me

An example of such a petro-pedagogy programme is from Energy4me, offered by the Society of Petroleum Engineers. Their home page states the following:

> Energy4me promotes fact-based education to help demystify the industry. It is designed to promote


**Figure 2.** The figure has been included with permission of Antonio F. Branco and Creators Syndicate, Inc. (left) and with permission of Eben McCue (https://ebenmccue.com/, last access: 7 July 2023; right).

> an energy conscious and educated society, and create interest in science, technology, engineering and math (STEM) careers. (Energy4me, 2024a)

On their page on sustainability, they acknowledge the movement away from fossil fuels: "Though the world is reducing its footprint and moving towards more sustainable and cleaner energy, it will be a slower transition than most expect" (Energy4me, 2024b; see also 2024c–d). Energy4me does cover climate change better than most petro-pedagogy sites, but a direct influence of fossil fuels on the climate crisis is still lacking.

#### Shell NXplorers

NXplorers is "Shell's flagship education programme" (Shell, 2024). The Shell educational programme is better than most fossil fuel companies, mentioning renewable energy, greenhouse gases, the Paris Agreement, climate change, and that the burning of fossil fuels produces carbon dioxide. However, aspects of petro-pedagogy are present in the programme. Shell's vital solutions to a low-carbon future include natural gas and carbon capture and storage and that some industrial sectors "will continue to rely on hydrocarbons for decades to come" (Shell NXplorers, 2018; see also Shell, 2018). Shell acknowledged climate change, but only as a long-term issue. NXplorers was included in a list of the "growing problem" of "children's marketing in schools" (Reclame Fossielvrij, 2024).

### 3.4.2 Europe

#### Agri Aware

Most corporate examples of climate denial in the classroom are connected to the petroleum industry, but Agri Aware in Ireland is associated with the agricultural industry. Agri Aware states that it "provides a number of primary and secondary programmes that are all interlinked with the national school curriculum" (Agri Aware, 2022).

In an investigative report on the influence of the agriculture industry on what Irish students learn about climate change, John Gibbons examined Agri Aware, the National Dairy Council, and the Irish Farmers' Association-funded booklet "Irish Food A–Z" written by a former Agri Aware executive; they concluded the following:

> Big Ag proponents are influencing classrooms in Ireland with learning materials that misrepresent the role of agriculture in contributing to climate change, pollution, and biodiversity loss, *DeSmog* can reveal. This undue influence is occurring due to a lack of government oversight of educational resources provided to primary schools. (Gibbons, 2020)

#### BP educational service/Energising Futures

A notable organization in petro-pedagogy is BP, which: "has successfully embedded itself at the heart of elite UK science and education policy and practice networks" (Tannock, 2020; see also Gandolfi, 2021). The BP Educational Service (BPES) has had a significant influence on the UK school system:

- Overall, 84 % of UK schools are registered with BPES.
- Over 100 000 teachers are registered with BPES.
- Over 1.7 million students have used BPES (BP, 2023).

BPES has reinvented itself as Energising Futures (BPEF), which was launched on 20 February 2023.

BP works with the Association for Science Education (ASE) on its school programmes. The ASE site had a web page on key "collections" from BPES, including Climate.Speaks, which "introduces arguments positioned through different stakeholders such as government, activists, energy and transport companies, and agriculture" (Association for Science Education, 2020). However, Climate.Speaks no longer exists on the BPES or BPEF websites. Not long

after I contacted the ASE about Climate.Speaks no longer being on the BP websites, the web page of ASE was taken down.

Very little information on climate change appeared on the new BPEF website anywhere (BP, 2024a, b). Climate change and its connection to the burning of fossil fuels are given a perfunctory recognition. Tannock found that the petro-pedagogy of BPES "poses a significant threat to our collective efforts to tackle the global climate crisis" (Tannock, 2020). No indication of BPEF being any better was found.

#### Scientix

The interaction of oil industry representatives with secondary teachers and students is supported by the European Union (Andrée and Hansson, 2023, p. 2, p. 5). Andrée and Hansson looked at Scientix (EU-funded programme for advancing STEM teaching) promoting careers in the petroleum industry for secondary science students and concluded that

> the petrochemical industry representatives communicated petro-pedagogy interests, beliefs and narratives directly to students participating in classrooms across Europe … it might be difficult for teachers as well as policymakers to see through the "smokescreens" of the webinars. (Andrée and Hansson, 2023, p. 13)

Their webinars (Scientix, 2024) on career paths, produced in collaboration of the European Petrochemical Association (EPCA), were examples of petro-pedagogy by promoting the petrochemical industry as responsible corporate citizens, which were essential to modern society and saving the world from global environmental crises (yet distancing themselves from the role of fossil fuels in the climate crisis).

#### Shell's *It's All About Energy*

Petro-pedagogy in The Netherlands has been criticized by the group Fossielvrij Onderwijs (Fossil Fuel Education) and its sister organization Reclame Fossielvrij (Advertising Fossil Free). Fossielvrij Onderwijs criticized the educational programmes of the Dutch energy-industrial complex, such as those of Shell: "Whatever they teach children, it is fundamentally wrong for them to be in front of the classroom. The fossil industry puts its own business model above the interests of these children to grow up safely and healthily. They present children with a world view that is already outdated" (Fossielvrij Onderwijs, 2024). Fossielvrij Onderwijs placed Shell second in a ranking of Dutch climate deniers because of their "misinformation campaign aimed at children" (Fossielvrij Onderwijs, 2019b; see also Fossielvrij Onderwijs, 2019a; Reclame Fossielvrij, 2021; Sleegers, 2024; Duineveld et al., 2024).

### 3.4.3 North America

#### Canada

#### Alberta government

In April 2024, the Alberta government issued "The Guiding Framework for the Design and Development of Kindergarten to Grade 12", and the Vision Statement included the following:

> Students … will know the global significance of Alberta's vast oil reserves and Alberta's reputation as the most ethical producer of oil in the world. They will also understand the importance of natural resources in enabling and sustaining Alberta's society and Albertans' quality of life. Students will learn about advancements for cleaner extraction of natural resources and about renewable energy sources. (Alberta Government, 2024, p. 10)

In terms of climate change the document included that "students will learn … about environmental stewardship and sustainability, with content about natural historic and prehistoric cycles of climate change … scientific data related to human impacts on the environment and climate, including global warming" (Alberta Government, 2024, p. 13). An article from CTV News raising concern about the changes to the school curriculum was titled "Kids to learn Alberta is 'most ethical producer of oil in the world' in school" (Amato and Penrose, 2024).

#### Energy Champions

FortisBC reports that "We work together with organizations to provide educational materials to teachers and students around energy efficiency, conservation and how to be positive environmental stewards" (FortisBC, 2024). Their programmes include Energy is Awesome for grades 2 to 5 (the company has suspended this programme) and Energy Champions for K-7 in partnership with the popular Canadian Football League (CFL) team BC Lions (Canadian Football League team in Vancouver) promoting the programme. Energy Champions is about energy conservation and building a low-carbon energy future. The FortisBC website provides few details about their educational programmes.

A review of climate education by FortisBC criticized their programmes to be a "sales pitch" by the company (Cruickshank, 2022; see also Gamage, 2022). Emily Eaton had been quoted in the article:

> But what many people have called the new climate denialism is this idea that we're actually denying the scale and speed, or pace, of the changes that are needed to rescue a habitable planet. And so that's the kind of denial that I see in these types of resources. (Cruickshank, 2022)

### Energy Creates

A new programme in Canada is Energy Creates, which is offering five scholarships of up to CAD 100 000 for youths 15 to 25 to attend post-secondary institutions (Energy Creates, 2024a). Energy Creates is not directly in schools but is aimed at youth planning to go on to post-secondary education.

The generous scholarships offer a unique opportunity for students, but there is a catch – all applicants must watch the film *Global Warning* (Energy Creates, 2024b) to be eligible for the major scholarship. Applicants must then pass a test on the movie and then prepare a creative work on the Canadian energy sector. The film, written and directed by Matthew Embry, is on climate change policy and science, including the opinions of oil apologists (e.g., Danielle Smith, Gwyn Morgan, Alex Epstein, and Fritz Vahrenholt) and contrarian scientists (e.g., Patrick Moore and Ian Clark). Overall, Energy Creates is a combination of oil apology and direct climate denial.

### Inside Education

An Alberta-based organization Inside Education has a mission to "support teachers and inspire students to better understand the science, technology, and issues related to our environment and natural resources" (Inside Education, 2024). Inside Education has been promoted by the Canadian Energy Centre, which is sponsored by the Alberta government (CEC Staff, 2023). Part of their programme "Stewardship, Energy, Climate & You" includes a teacher's guide, which provides a reasonable enough snapshot of climate change on the surface, including the increase in extreme weather events associated with global warming. However, the Guide promotes personal action and not collective action or policies to restrict the production of fossil fuels (Inside Education, 2018; see also Eaton and Day, 2019, p. 465; Hodgkins, 2010).

### Safety in Schools Foundation

Safety in Schools (SiS) Foundation offers occupational health training courses to high school students (Safety in Schools Foundation, 2024). In October 2023, SiS issued an announcement promoting the energy literacy programme of Inside Education and others but made no mention of the participation of SiS" (Safety in Schools Foundation, 2023a). Two months later, SiS launched their Energy Career Literacy programme, where "students can access invaluable industry insights, resources, potential employers, mentorship opportunities, and much more" (Safety in Schools Foundation, 2023b). In the fall of 2023, SiS also lobbied the Alberta government to include oil and gas studies in the curriculum for junior high and high school (Amato and Penrose, 2024).

### SEEDS Connections

Another fossil fuel industry sponsored organization, SEEDS Connections, provided "educational programmes related to leadership, environment, energy and diversity, for Kindergarten to Grade 12 students across Canada … and distributes this programme to over 2000 schools across Canada" (SEEDS Connections, 2019a). A web page is titled "Teaching Activities for Climate Change", which only promotes energy saving and completely ignores the problem with burning fossil fuels (SEEDS Connections, 2019b). Their website has not been updated for the last few years. SEEDS Connections has been accused of promoting propaganda in schools (Eaton and Day, 2019, p. 463, p. 466).

### Ten Peaks Innovation Alliance

Ten Peaks describes itself as a "not-for-profit with a mission to engage, inspire, and educate Alberta's youth about energy, the environment, and our climate and how they can play an essential role in the future of our province" (Ten Peaks, 2024). Not much information on climate change (Ten Peaks, 2020) was found in their website, but many details related to fossil fuels populated the site.

Many of the above organizations demonstrate that petropedagogy in Canada is Alberta-centric, which comes as no surprise since this province is the centre of the oil and gas sector. More information on climate education in Canada can be found in "Climate Change Education within Canada's Regional Curricula: A Systematic Review of Gaps and Opportunities" (Field et al., 2023; see also 2019) and Canada's entry in Profiles Enhancing Education Reviews (PEER; UNESCO, 2022b).

### United States

A survey ($N = 938$) found that 75 % of registered voters in the US supported the idea that "schools should teach children about the causes and consequences, and potential solutions to global warming"; the results varied by political affiliation:

- Liberal Democrats – 98 %,
- moderate Democrats – 91 %,
- moderate Republicans – 77 %,
- conservative Republicans – 40 % (Leiserowitz et al., 2023b; see also Lange, 2023).

Political initiatives have been attempted at the federal level on climate education – namely, the Climate Change Education Act, which was first introduced by Senator Barack Obama and Representative Michael Honda in 2007 (under the name of the Global Warming Education Act), which was re-introduced by Senator Edward Markey (Markey, 2021) and Representative Debbie Dingell (Dingell, 2021); the bill was introduced again in 2024 (Markey, 2024; Dingell, 2024).

Education in America is decentralized and generally controlled by the state. In the last 5 years, 90 proposals have been introduced in 21 states to support climate change education (Branch, 2024). A review of climate education has warned about the following:

> The story of climate education in the US has to also include examples in which states or school districts are actively fighting against teaching that the climate crisis is real and that it is damaging to the planet. (Coon et al., 2024, p. 26)

Climate Changemakers had initiated an email campaign to have climate change included in the state education standards and to teach educators about the climate crisis (Climate Changemakers, 2020).

Climate education is included in the important K-12 content of Next Generation Science Standards (NGSS; a collaborative, state-led process of 26 states called Lead State Partners), which recommends the teaching of climate change beginning in middle school, ages 11–13:

> Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behaviour and on applying that knowledge wisely in decisions and activities. (Next Generation Science Standards, 2017, p. 59)

The NGSS had been adopted by 20 states, and 24 others are using them as guides (National Center for Science Education and Texas Freedom Network, 2020, p. 2) for their science curriculum, and in 2022, Pennsylvania became the latest state to use the NGSS as a guide (Branch, 2022), leaving only five states not using the NGSS to some extent at least.

The National Center for Science Education (NCSE) and the Texas Freedom Network Education Fund prepared a state-by-state report card on public school science standards on climate change. The grade of the 20 states following the NGSS was a B+, and 10 states received poor grades (those in italic font were not guided by the NGSS in 2020): *Florida*, Indiana, *Ohio*, and West Virginia received the D grade and Alabama, Georgia, *Pennsylvania*, South Carolina, *Texas*, and *Virginia* received the F grade (National Center for Science Education and Texas Freedom Network, 2020).

Previously, in late 2014 to early 2015, an extensive survey ($N = 1500$) was conducted on climate education in American schools by the NCSE. Among science teachers in middle and high schools, 75 % discussed global warming for at least one class, but almost a third were teaching that according to many scientists, recent global warming was "likely due to natural causes" (Plutzer et al., 2016a, pp. 15–16; see also 2016b).

A study of climate education reviewed "802 publicly available education policies across the United States" and

> used a whole institution approach for data collection and analysis and considered four institutional domains of potential climate change activity: (1) institutional governance, (2) teaching and learning, (3) facilities and operations, and (4) community partnerships. (MECCE and NAAEE, 2022, pp. 4–5)

Among their findings was that all states had policies mentioning climate change, but 33 states had very low focus, and 14 states had low focus on climate change content (MECCE and NAAEE, 2022, pp. 9–11, p. 24, p. 40). States that followed the NGSS were more likely to include climate change content (p. 9, pp. 24–26). When energy was taught, little mention of climate change was presented (p. 9, pp. 31–37). The report highlighted the issue of climate denial: "For decades, political and social will to act on climate change was quickly swept away in a current of denial, avoidance, and political posturing" (MECCE and NAAEE, 2022, p. 3; see also p. 7, p. 28, p. 44).

In "Miseducation, How Climate Change is Taught in America", investigative reporter Katie Worth identified cases of interference in American schools by the energy-industrial complex and writes about the "intentional miseducation of our children" (Worth, 2021a). Similar results were reported in a series of podcasts and reports by Noor and Westervelt (Noor and Westervelt, 2023), "The ABCs of Big Oil". And a video by Climate Town presents an excellent overview of "The Brainwashing of America's Children". Early in the video, the narrator Rollie Williams commented:

> The oil and gas industry has spent millions of dollars trying to influence American school children … there is a massive paper trail of oil-funded lesson plans and workbooks. They produce propaganda videos and pro fossil fuel cartoons … and a whole gaggle of shady tactics to push their agenda on kids … these efforts to influence what children hear in public schools seem to be working. (Climate Town, 2023)

Below are organizations of petro-pedagogy and conservative climate denial infiltrating American schools (for more on American climate education, see Bhattacharya et al., 2020; UNESCO, 2023).

### Arkansas Energy Rocks

This group offers education programmes for students and teachers:

> The Arkansas Energy Rocks Education Outreach Program was created to bring the oil and natural gas industry to classrooms across the state. This programme provides curricula and programmes to reach students from elementary school through high school. (Arkansas Energy Rocks, 2019a)

A website page for students provides a link about "Addressing Climate Change and Energy Production"; the link is to the American Petroleum Institute (Arkansas Energy Rocks, 2019b).

Such petro-pedagogy organizations exist in many states (four more are discussed below); in their detailed study, Katie Worth located such groups in "Alaska, Arizona, California, Colorado, Florida, Illinois, Kansas, Kentucky, Michigan, Montana, Nevada, New Mexico, New York, North Carolina, Ohio, Pennsylvania, South Carolina, Texas, Utah, Virginia, West Virginia, Wisconsin, and, of course, Arkansas" (Worth, 2021b; see also Coon et al., 2024, p. 26).

### $CO_2$ Coalition

A well-known conservative climate-denial group is the $CO_2$ Coalition (DeSmog, 2024b). They describe themselves as "comprised of more than 100 of the top experts in the world who are sceptical of a theoretical link between increasing $CO_2$ and a pending climate crisis while embracing the positive aspects of modest warming and increasing $CO_2$" ($CO_2$ Coalition, 2023, p. 1).

On 23 March 2023, they issued a booklet attacking the position of the National Science Teaching Association on climate change, using standard climate-denial talking points. The final conclusions of the booklet were the following:

> As a result, students are undergoing an indoctrination into a dangerous political agenda that ignores the enormous benefits of $CO_2$ … We respectfully urge the National Science Teaching Association to seriously consider a rejection of their previous endorsement of scientific censorship and return science education to the foundations of reason, open scientific debate and tolerance for alternative thinking. ($CO_2$ Coalition, 2023, p. 16)

The booklet was released as the National Science Teaching Association was holding a convention where the $CO_2$ Coalition had a booth and distributed the booklet and a comic book *Simon the Solar-Powered Cat* depicting carbon dioxide as being good for the planet. An article in the *Washington Post* about the episode warned that the $CO_2$ Coalition literature could cause teachers to spread propaganda about the science of climate change to their students (Joselow, 2023).

The latest "educational comic book" of the $CO_2$ Coalition was described as follows:

> *Once Upon a Time*: A true story about the miracle molecule–carbon dioxide provides scientific information in a manner that is simple enough that even a young child can enjoy and understand … carbon dioxide ($CO_2$) is the miracle molecule that is necessary for life on earth to exist and that increasing $CO_2$ is helping plants to grow faster and bigger. ($CO_2$ Coalition, 2024)

On the web page for this comic book, a comment is made on how children have been taught incorrectly, as carbon dioxide is not the "demon molecule", but the "miracle molecule" ($CO_2$ Coalition, 2024). A request to $CO_2$ Coalition for permission to post the cover cartoon of *Once Upon a Time* received no response.

### EverBright Media

EverBright Media, a for-profit organization founded by former Arkansas governor Mike Huckabee, claims that "more than 700 000 families are enjoying [their] products" (EverBright Media, 2024a). Their pamphlets, decorated with cartoon covers, include the "Kids Guide" to "Free Markets", "Fighting Socialism", and "The Truth about Climate Change" (EverBright Media, 2024b). Regarding the latter, issued in 2023, one commentary concluded, "they deliberately undermine children's scientific education … They're not just trying to create climate sceptics … They're actually eroding trust in science and the scientific community" (Gopal, 2023), while another had the title "Huckabee's climate-denial book targeted at children" (Fisher, 2023). When the website of EverBright was checked again in June 2024, the "Kids Guide to The Truth about Climate Change" could not be found. A request to EverBright for permission to post the cover cartoon of "Kids Guide to The Truth about Climate Change" was declined.

### Heartland Institute

The conservative think tank Heartland Institute states what they do: "We focus on issues in education, environmental protection, health care, budgets and taxes, and Stopping Socialism" (Heartland Institute, 2024a). On their web page announcing the release of *Climate at a Glance* (see below), Heartland proudly publicized that "*The Economist* magazine called Heartland 'the world's most prominent think-tank promoting scepticism about man-made climate change"' (Heartland Institute, 2023).

In 2009, a booklet from Heartland, "The Skeptic's Handbook", challenged "conventional wisdom" on global warming and was sent to 14 000 public school board presidents (Taylor, 2009). The contents were debunked by a series of posts on *DeSmog* (Jacquot, 2008).

Six years later, the so-called Nongovernmental International Panel on Climate Change (NIPCC), supported by the Heartland Institute, prepared *Why Scientists Disagree about Global Warming* (Idso et al., 2015). The book dismissed the

scientific consensus on climate change and accused the IPCC of not being a credible source. The Heartland Institute distributed 300 000 copies of the book to K-12 and college science teachers in the US (Heartland Institute, 2024b). This elicited an angry response from the executive director of the National Science Teaching Association, warning its members of the propaganda (see Bast, 2017), and a complaint by the NCSE about Heartland forcing its "climate change denial literature on science teachers" (Branch, 2017; see also Lee and Banerjee, 2017; McKenna, 2017, 2018; Climate Town, 2023). Senator Sheldon Whitehouse described the climate-denial propaganda by the Heartland Institute on the floor of the United States Senate:

> I would like to explore the Heartland Institute's latest gambit, which is to airdrop climate-denial propaganda directly into children's classrooms.
>
> What we don't need are fossil fuel front groups pumping out more phony science to pollute public education, just like they pollute our oceans and atmosphere. (Whitehouse, 2017)

Another assault against climate education from the Heartland Institute was the book – *Climate at a Glance for Teachers and Students* (Watts and Taylor, 2022) – mailed out to 8000 middle and high school teachers in early 2022. The banner for the release of the book read that the "Book intended to be 'supplemental' to standard curricula and counter alarmist narrative with facts on the climate that reflect current data and research" (Heartland Institute, 2023; see also Climate at a Glance, 2024).

The Heartland Institute, EverBright Media, $CO_2$ Coalition, and PragerU (see below) are typical conservative climate-denial organizations. The $CO_2$ Coalition is unique among this group as climate denial is their only focus.

### Illinois Petroleum Resources Board

The goal of the Illinois Petroleum Resources Board is to "improve the image and credibility of the Illinois oil and gas industry", and this is accomplished through seven objectives, of which the first is "Education: create an understanding of the Illinois oil and gas industry and good safety practices through programmes with schools, organizations and the public at large" (Illinois Petroleum Resources Board, 2024a). They offer a series of professional development programmes for middle and high school teachers (Illinois Petroleum Resources Board, 2024b). No connections between fossil fuels and climate change were found on their website. Blogs on their website generally defended petroleum, including one titled "Benefits of Fossil Fuels to Humanity Have Far Outweighed Negatives" (Whitehead, 2022).

An article criticizing the Illinois Petroleum Resources Board was called "A Fossil Fuel Miseducation", which stated, "the IPRB doesn't appear to deny climate change – they mostly seem to avoid mentioning it at all. Instead, the group focuses on economic arguments about the oil and gas industry, which they claim will be a good source of jobs for decades to come, despite mounting evidence to the contrary" (Gopal, 2024).

### Kansas Strong

Kansas Strong is "providing accurate information, they are helping Kansans learn more about the realities of the energy industry to create a more informed society and prepare for the future" (Kansas Strong, 2024a), and the organization offers "workshops with curriculum for K-12 teachers and students. Kansas Strong's curriculum and lesson plans are designed to meet Kansas State Department of Education Teaching Standards" (Kansas Strong, 2024b). Programmes for various grades of students are also available (Kansas Strong, 2024c). Few details of the education programmes were provided. A statement was found on climate change that "natural gas production and achieving climate goals are not mutually exclusive" (Kansas Strong, 2024d).

### Ohio Natural Energy Institute

The Ohio Natural Energy Institute "is dedicated to educating people about the indispensable industry that makes life better for every Ohioan" (Ohio Natural Energy Institute, 2023a), and "natural energy" to them is natural gas and oil. Their website has sections for both students and teachers, offering a variety of one-page pamphlets praising the fossil fuel industry. Teacher workshops have been attended by 3310 educators from 1632 schools in the state (Ohio Natural Energy Institute, 2023b). No mention of climate change or global warming was found on their website, but their home page did boast of a 37 % reduction in emissions without acknowledging why such emission reductions were important. The group has been accused of indoctrinating children with the benefits of fossil fuels while ignoring how fossil fuels contribute to climate change (Zou, 2017).

### Oklahoma Energy Resources Board

Five state petro-pedagogy organizations are discussed in this review, Arkansas Energy Rocks; Kansas Strong; Illinois Petroleum Resources Board; Ohio Natural Energy Institute; and, as the earliest, Oklahoma Energy Resources Board (OERB). An issue with OERB's climate education is their cartoon mascot Petro Pete, who appears in their audiobook series, "Petro Pete's Adventure" (Oklahoma Energy Resources Board, 2022a), and in their curriculum called "Little Bits" for K to second-grade students (Oklahoma Energy Resources Board, 2022b) and "Fossils to Fuel 2" for third- to sixth-grade students (Oklahoma Energy Resources Board, 2022c). Workshops for teachers are offered at no cost, along with a stipend of USD 100 to teachers. The Center of Public

Integrity has pointed out that "Oklahoma remains the epicentre of oil-industry puffery in the classroom" (Zou, 2017; see also Wertz, 2017; Atkin, 2020; Tannock, 2020; Worth, 2021b; Climate Town, 2023). A request to OERB for permission to post the cover cartoon of "Petro Pete's Adventure" received no response.

### PragerU

Prager University, well known for its climate-denial views (DeSmog, 2024c), is a conservative media outlet and not an accredited academic institution. However, in the summer of 2023, videos by PragerU were allowed in Florida schools. An article in *Scientific American* criticized the adoption of the PragerU material by the state in an article titled "DeSantis's Florida Approves Climate-Denial Videos in Schools" (Waldman, 2023b; see also Waxman, 2023). Other states have expressed interest in the PragerU programmes, including Montana, New Hampshire, Oklahoma, and Texas (PragerU, 2024a; see also 2024c).

In an article from their *PragerU Educational Magazine for Kids* named "Ania's Energy Crisis", climate change is presented as an "unproven and debated" theory (PragerU, 2024b, p. 6). While Ania supports action to phase out fossil fuels, her parents want her to hear "the other side" (PragerU, 2024b, pp. 12–13). Her father, who "reads scientific journals and talks with researchers at his university", shares a series of standard climate-denial talking points with his daughter, and her mother also chimes in with more climate-denial points. Finally, the young girl wonders if it was possible that she had only been taught one side of the story. Ania is quickly learning the denial lesson to doubt the science of climate change, and so will other children who read this story. A request to PragerU for permission to post the cover cartoon of "Ania's Energy Crisis" received no response.

### STEM Careers Coalition of Discovery Education

The STEM Careers Coalition of Discovery Education lists the American Petroleum Institute and Chevron as content partners: "Content Partners will support expanded student impact while sharing existing inspirational and high-quality content and provide subject matter expertise" (Discovery Education, 2024a; see also Winkel, 2022). The STEM Careers Coalition reached over 10 million students by the end of 2024 (Discovery Education, 2024b). One of their STEM Careers Coalition programmes is a lesson plan for grades 3 to 5 called Effects of Petroleum on Our World, which makes no mention of climate change (Discovery Education, 2022). A programme was found on the impact of climate change on health (Discovery Education, 2024c). The STEM Careers Coalition is another petro-pedagogy programme.

### Switch Energy Alliance

Switch Energy Alliance is known for its films and videos promoting fossil fuels globally. The chairperson and founder of the group is Scott Tinker, a professor of geology at the University of Texas. In *Scientific American*, Scott Tinker stated, "Unfortunately, those who are the most passionate about addressing climate change seem to not like the answers from the energy experts" (Tinker, 2019b; see also Tinker, 2019a, 2023).

Switch Energy Alliance is "dedicated to inspiring an energy-educated future that is objective, nonpartisan, and sensible" (Switch Energy Alliance, 2024a). One of their programmes, Switch Classroom, "provides innovative tools and expert-driven content to enable students to think critically about energy" (Switch Energy Alliance, 2024b). No information was found on the importance of reducing the burning of fossil fuels to resolve the climate crisis, but criticisms were often raised about renewable energies.

## 4 Discussion

The science of climate change has done just fine against climate denialism, and the science has only grown stronger over time. The problem has been that a glaring gap has opened between scientific knowledge and public audience perception of that knowledge (and the scientific consensus). A large portion of the public audiences has this issue, which can negatively affect all aspects of climate education, as school boards, teachers and parents may suffer from the consensus gap. As the energy-industrial complex has poured millions of dollars into PR firms to promote its propaganda against the scientific consensus, climate denial has crippled climate communication and has had negative influence on climate education.

The influence of climate denial is far-reaching. Even during the public viewing of the preprint of this paper on the EGU interactive community platform (EGUsphere), the first comment began with the following:

> It is not serious to use the phrase "climate denier", since no one [sic] denies that climate exists.
>
> According to climate science, there is no climate crisis and no climate emergency. IPCC AR6 mentions "climate crisis" only once and then to notice that media have started to use the phrase, not to claim that there is a climate crisis.
>
> Data from the real world show clearly that nothing bad is happening to the climate, and that there is no climate crisis. (CC1, 2024)

Other climate-denial comments followed (see also the example in the Introduction of this review).

Climate denial has been able to dampen social and political will to act to stop the climate crisis. Climate denial by

the energy-industrial complex and by climate-denial organizations (and politicians) have invaded classrooms in some places. This review is a call to arms before irreparable, long-term damage is done to the school system and knowledge building on the climate crisis. This is particularly important for children who live in regions that are conservative and/or connected to the energy-industrial complex (more so when also underfunded by the government). Organizations in two camps are promoting climate denial disguised as educational programmes:

1. *Climate-denial organizations*. The promotion of conservative values and denying the science of climate change (for example, $CO_2$ Coalition, Energy Creates, EverBright Media, Heartland Institute, and PragerU). This group has a larger and more direct climate-denial footprint compared to petro-pedagogy (and more information, therefore, is available than with the petro-pedagogy organizations, as presented above).

2. *Petro-pedagogy organizations*. The promotion of fossil fuels and ignoring the science of climate change (for example, Energising Futures, Energy4me, Energy Champions, Inside Education, NXplorers, Oklahoma Energy Resources Board, Scientix, STEM Careers Coalition, and Switch Energy Alliance). This is a less overt, but probably more insidious, form of climate denial and is climate denial by omission of climate change issues.

### 4.1 Recommendations

Future research on both types of climate-denial organizations is recommended, especially

- to explore the situation in countries not mentioned in this review;
- to study if a recent surge in organizations promoting climate denial have developed;
- to determine (a) how effective these organization have been in getting climate denial into schools, (b) what their impacts are, and (c) what can be done to mitigate their impact.

An authoritative source of the scientific consensus on climate change is the assessment reports of the IPCC. However, the crucial anti-science role of climate denial needs to be recognized more precisely by the IPCC instead of scattered loosely throughout their reports. The science of climate denial is now more important than the science of climate change itself in terms of climate policymaking, but the IPCC does not fully appreciate this. The IPCC has always had a report on the physical science of climate change, but policymakers and the public audiences would be better served if the IPCC issued a separate report on the social science of climate denial in future assessments. Additionally, PR professionals could be hired by the IPCC to prepare and promote new IPCC Summaries:

- "Summary for the Public" to give climate communication a fighting chance,
- "Summary for School Children" as part of the "Summary for Teachers",
- "Summary for Teachers" as an aid in climate change education.

Two lead authors of the AR6 of the IPCC have recently prepared an article for young readers about greenhouse gas emissions and climate change (Peters and Meinshausen, 2024).

Social scientists have identified the sources, tactics, impact, and other aspects of climate denial but have also inadvertently portrayed climate denial as a legitimate response by conservatives seeking to uphold their world view. This can appear to normalize climate denial to the casual observer. Climate denial, by delaying necessary legislation on a global crisis, represents a form of deviant behaviour as lives are placed at risk so that certain conservative values are protected. Deviant behaviour associated with climate denial and its social movement is rarely explored by social scientists, with McKie being a notable exception in their article "Climate change counter movement organizations: An international deviant network" (McKie, 2022).

### 4.2 Concluding reflections

Much of the world has limited knowledge of the science of climate change. This is despite decades of climate science and climate communications. The energy-industrial complex and climate-denial organizations are partly responsible for this as they have turned their attention more to schools.

Teachers, parents, and students should be on the lookout. An early study about science denial in the classroom was a portent to climate educators:

> In this feature, I began by considering organized and intentional denialism, about which every honest scientist and educator must be concerned … Teachers and students who recognize the role of science in our society should be able to recognize a denialist tactic when they see it. (Liu, 2012, p. 134)

Over a decade later, the propaganda campaigns promoting climate denial in the classroom have escalated, as discussed in this review.

Damico and Baildon in their book *How to Confront Climate Denial* wrote the following:

> Over time, we have come to understand that our teaching and learning about climate change must deal much more directly with *climate denial* … We have come to identify climate denial as arguably


**Figure 3.** Photo credit goes to Mike Baumeister on Unsplash.

> the most consequential topic of our time … chart a course for making climate denial a curricular and instructional priority in schools. (Damico and Baildon, 2022, Preface)

The National Center for Science Education has taken a strong stance against climate denial in schools. The NCSE warned, "Teachers, administrators, and community members must remain vigilant against efforts to introduce denial into classrooms … Owing to organized efforts by climate change deniers, there is a wealth of well-presented misinformation available online and in some cases mailed directly to teachers" (Plutzer et al., 2016a, p. 33). The NCSE also has a web page on "The Pillars of Climate Change Denial", which provides information for challenging climate denial because it is "critical to defend the teaching of climate science" (National Center for Science Education, 2016). In 2023, the NCSE harshly criticized the deceitful tactics of climate-denial organizations:

> Cartoons and jokes and lies: that's the recipe for climate change denial aimed at kids, sometimes kids as young as 6 years old, judging from recent campaigns from conservative outfits … Whatever its source, it's dismaying that such propaganda is aimed at so young an audience. (Reid and Branch, 2023)

In their famous Cranky Uncle series, John Cook has prepared the "Teachers' Guide to Cranky Uncle" on how to deal with climate denial in schools, which states the following:

> Familiarity with denial techniques is key to logic-based inoculation – learning each rhetorical technique equips people to spot these misleading tactics in misinformation … "One student summed it up perfectly when she said that it's 'helpful to know when you're being lied to'. And that's the point … Learning how not to be fooled is empowering. (Cook, 2021, pp. 7–8)

Eaton and Day concluded that "Preparing students for this future, thus, involves the urgent need to dismantle the corporate power of the fossil fuel industries and their petropedagogy" (Eaton and Day, 2020, p. 470).

Raising awareness of the cagey practices of climate denial in public education will help identify and prevent it. Kids agree that no room exists for climate denial in their classroom (Fig. 3).

**Data availability.** No data sets were used in this article.

**Competing interests.** The author is a climate activist on social media and has written op-eds in news media opposing climate denial and has published a book on climate denial in American politics which has been used as a reference in this paper (Kutney, 2024). These have been declared to identify any potential biases or self-promotion. The peer-review process was guided by an independent editor, and the author has no other competing interests to declare.

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