Improve Energy Use and Reduce Greenhouse Gases in Indiana

Introduction

Recent years have brought heightened awareness to the profound impact of human activities on our global climate system. The proliferation of greenhouse gas (GHG) emissions, primarily stemming from the combustion of fossil fuels such as coal, oil, and natural gas, has lead to planetary warming, which has induced atmospheric instability. Manifestations of climate change, such as milder winters and increasingly severe storms in Indiana, are already occurring due to climate change. The projections get much worse, and in many areas of the world, these harsh impacts are already occurring, showcasing how this crisis doesn't affect everyone equally.

It is imperative for society to transition to a low-carbon economy. However, this is difficult given the entrenched reliance on fossil fuels for modern civilization and the complicated web of economic interests. There is movement in challenging the longstanding dominance of fossil fuel norms (6). It takes everyone to be involved, though 70% of GHGs have been emitted by corporate entities specifically, energy, transport, and agriculture, with an all-time high of CO2 emissions of 36.8 GtCO2 emitted in 2022 (6). GHGs encompass various gases, including carbon dioxide (CO2) and methane, emitted as byproducts. For the purposes of this analysis, GHGs and carbon are used interchangeably, reflecting prevailing accounting frameworks that translate all GHG emissions into CO2 equivalents for reporting and communication purposes.

The Paris Agreement of 2017 aimed to limit global warming to well below 2.0 degrees Celsius, a benchmark recommended by climate scientists, with the United States initially committing to a 26% reduction in emissions by 2025 before subsequent shifts in political leadership (5). As of 2022, the average American will burn 1840 metric tons of CO2 in their life time, which is roughly 4x that of the average person worldwide (12). In 2020, Indiana was in the top 10 of state GHG emitters, though it is 17th in terms of population (13). Some reports indicate the current global warming to be hovering around 1.5 degrees Celsius, so there is time for Indiana to be a leader in this transition to a low-carbon economy.

Problem Definition

The issue with GHG emissions produced at the current intensity is that it has far-reaching implications. Not only are environmental structures at risk, but also social, economic, and global political systems as well (3). GHG occur naturally so it is expected that they will be in our atmosphere, though the current production is far too high. Too many producers are emitting them at an unsustainable rate, posing a common pool resource problem.

We are experiencing great loss to both producers and consumers as a result of the externalities the GHG waste is activating. The resultant externalities manifest in escalating costs borne by both producers and consumers across human designed and environmental systems worldwide. Additionally, there are informational asymmertries, in that companies themselves don't know exactly how much GHG they are emitting because emissions are difficult to extract from supply chains.

In contrast to the rest of the world, the United States has relied on a non-central approach to policies to mitigate climate change (16). This regulatory void is compounded by the influence of fossil fuel industries in shaping policy landscapes, increasing lagtimes in adopting alternative approaches (9).Indiana is currently ranked 46th in the nation for air pollution, 20th in the nation for drinking water violations, and 36th on climate change policies (7) With this being the status quo in Indiana, there isn't sufficient incentive for companies to change how they currently do business. Effective policy interventions are essential to providing the necessary incentives—both punitive or incentivizing—to catalyze sustainable behavioral changes across industries.

The repercussions of current practices are starkly evident, with heatwaves, floods, droughts, and other extreme weather events exacting a heavy toll on human lives and exacerbating societal vulnerabilities (12). GHG emissions mitigation demands a comprehensive policy analysis focused on a range of values, of top consideration is improving the energy landscape.

Description of Alternatives

Status Quo

Indiana's regulatory environment currently lacks sufficient incentives to prompt businesses to address and modify their behavior in relation to environmental concerns. The predominant impetus for change appears to be emerging from an investor standpoint for sustainable business strategies rather than from government policy. Currently 1 in 5 Hoosiers live within 10 miles of a coal plant, and only 10% of energy comes from renewable electricity (RE) (13).

Recent developments have seen Indiana embark on its inaugural 'Climate Action Plan,' signaling a nascent step towards addressing climate challenge within the state. However, scrutiny reveals that while it serves as an informative framework, its scope and ambition are perceived as inadequate in tackling the magnitude of the problem. Critics argue that it represents only a modest initial stride.

Carbon Tax

One widely discussed policy option for addressing greenhouse gas emissions is the implementation of a Carbon Tax. This approach involves establishing a price on carbon emissions by setting a limit on the quantity of emissions allowable within a specified timeframe then charging a tax on emissions exceeding that limit. This would require that GHG emission tracking is taking place. Research suggests that this option could yield a significant reduction in the fossil fuel consumption (6).

The key strength of a Carbon Tax lies in its revenue-generating potential. The taxes collected can be allocated towards various initiatives aimed at furthering GHG mitigation objectives. Examples are sustainability/climate focused education, personal tax rebates for temporarily elevated energy costs, and payroll tax reductions to support RE transition. Each of these options supports the overall goal of reducing emissions and improving the energy landscape long-term.

Carbon Cap-and-Trade

Under the Carbon Cap-and-Trade approach regulatory authorities issue allowances to companies, dictating the maximum permissible level of GHG emissions each entity can generate. Doing so, would ensure companies are tracking their emissions. This framework effectively establishes a market for emissions, wherein companies are afforded flexibility in determining their emissions strategy.

Operating within this market, companies are presented with various options for compliance. Two options are to invest significantly in renewable energy sources and carbon-reducing technologies to decrease their emissions or to purchase additional allowances from entities that have surplus allowances. This policy framework uses incentives for reducing emissions and allows for flexibility in business strategies. It fosters a transitions towards a low-carbon economy while addressing climate change mitigation now.

Energy Efficiency Regulation

The implementation of performance standards for buildings, infrastructure, vehicles, and systems including energy usage and emission quotient. Regulations focus on ensuring that these assets meet specified efficiency and emissions criteria. Such standards effectively reduce the carbon intensity of energy consumption across sectors, especially when implemented at the utility level (9).

Research indicates that the adoption of performance standards has the potential to deliver substantial energy savings and emissions reductions. Studies have documented energy savings of up to 20% in industrial settings and 12% in the transportation sector, underscoring the effectiveness of such measures in mitigating greenhouse gas emissions (6). This type of incentive can drive innovation, enhance productivity, and promote sustainable economic growth while also mitigating GHG.

Low-Carbon Technology Investment

Provide grants and subsidies to businesses working on the transition to a low-carbon economy. By offering financial assistance and technical support to businesses committed to reducing their carbon footprint, policymakers aim to incentivize innovation and investment in RE technologies, energy-efficient practices, and sustainable production methods. This type of policy seeks to rapidly increase the number of technologies available and able to meet the needs of society, and one of the most prominent examples of positive change is in the expansion of renewables (6). By leveraging the collective expertise and resources of businesses, policymakers can catalyze transformative change and accelerate progress towards climate mitigation goals

Fossil Fuel Phase Out to a Corporate Death Penalty

This policy option gives companies a set amount of years to phaseout their emissions by use of fossil fuels then hold them to the 1000 ton CO2 rule. It states that everytime humanity burns this much GHG a future person's life is lost. This policy would charge a company above the current number of employees that they have (12). Under this policy instrument, companies are held accountable for the societal costs associated with their emissions by use of a quantifiabl measurement. This policy establishes a powerful disincentive for GHG emissions. Companies

are incentivized to internalize the societal costs of their emissions externalities and prioritize emission reduction measures to model responsible behavior in the context of climate change. By integrating principles of intergenerational equity and harm minimization, this policy instrument represents a proactive and forward-thinking approach to mitigating the impacts of climate change and safeguarding the well-being of future generations.

Evaluative Criteria

The policy options will be assessed based on the following criteria. **Effectiveness** defined as the ability to diminish GHG intensity with agility and longevity while continuing to provide adequate energy to meet the demand needs of society. The second criteria is **efficiency** with a focus on how the policy establishes incentives or disincentives for agents to align in a way that moves the market towards maximum social surplus. This criteria also seeks to reduce the information asymmetry. The third criteria is **equity** based on how it impacts the health and employment potential of all people, as well as supports all businesses in their ability to navigate the transition financially. **Feasibility** will assess the likelihood that a policy would pass within the Indiana political climate. Additional criteria includes an analysis of the cost and time needed to drive the outcomes.

Assessment of Alternatives

Status Quo

As of 2018, Indiana was the 8th highest emitter of GHG emissions nationwide with 24.4 metric tons per person (1). Indiana's policies have left it in the bottom of rankings for pollution and climate change approach. The primary source of energy is from coal which makes sense as it has five coal plants (15). Recently a transition to natural gas has been a focal point, which is a comparably *cleaner* source of energy, though still a high emitter of GHG compared to RE.

Given that Indiana ranks very low for air quality is an indicator that there is a social surplus that is being lost. The externalities of air pollution and GHG emisions are not being remedied under current policy.

When viewing through an equity lens, starting with employment, 10% of Indiana's workers work within the energy sector. Nearly 17,000 workers in Indiana work in coal, oil, or natural gas generation whereas 10,500 work in solar or wind; There is a 3.5% unemployment rate compared to 3.9% nationally (14). Whereas employment is stable under current policies, the health of Hoosiers is not benefitting.

Even with the recent adoption of a Climate Action Plan, there are no active regulations that provide incentives to reduce GHG emissions. Recently, Indiana state passed regulation stating that municipalities do not have the autonomy of restricting natural gas use in new development indicating its political preference to resist a transition to low-carbon economy (8). It is reasonable to assume many of the coal and natural gas firms in Indiana are here because there is friendly policy and political stance towards their work (2)

Carbon Tax

The implementation of a Carbon Tax holds promise for swiftly reducing GHG emissions, with potential for long-term stability depending on the design of accompanying recycling measures (5). Research indicates that while the effectiveness of carbon tax policies may vary depending on their design, they have demonstrated tangible impacts on high emitting sectors such as transportation and energy (6). Carbon Taxes also have stimulated energy efficiency improvements and investments in RE generation, particularly when tax revenues are reinvested into the market (6; 11).

A Carbon Tax introduces a strong disincentive for businesses to consume excessive energy. While these policies may not directly mandate a shift to RE, they can incentivize adoption of clean technologies and serve as a catalyst for market innovation (2). That said, these types of policies can have mixed results on rapid expansion of RE because investors may not have faith that change can be sustained by the market alone, whereas they are suggested as a top option to promote consumer acceptance (11 ;9). They are identified as impactful when mitigating negative externalities, with the benefits to the environment outweighing temporary economic costs (5).

From a financial standpoint, a Carbon Tax is equitable insofar as it levies charges based on a company's GHG emissions rate, with higher emitters subject to greater taxation (5). Depending on how the tax is recycled depends on how equitable this program would be in this regard. Companies may have to make cuts if they aren't able to make the transition smoothly. There have been results indicating small effects for stringent policiesthough an increase in the cost of electricity by 10% would drop employment by 16.5% depending on policy design and state trade make-up (2). From a health perspective, businesses will have an incentive to reduce their emissions as fast as possible, which looks promising (5).

The feasibility of implementing a Carbon Tax in Indiana may face obstacles, given the political landscape and potential resistance from coal and natural gas industries. Abatement costs could be disproportionately burdensome for these sectors, complicating the policy's passage (2). That said, Hoosiers have said that they would be willing to pay $2/month for energy from renewables (13). Furthermore, concerns regarding market responses and carbon leakage may be rise of caution to prevent unintended economic consequences (2). However, revenue generated from the tax could be channeled towards supporting the transition in major energy sectors within the state, potentially easing inindustry adaptation.

Carbon Cap-and-Trade

This policy is extremely effective as it ensures in concept that only a certain amount of GHG will be emitted over a period of time. The impact of this rule is increased when there is a phased decrease in the amount of GHG allowed over a given amount of time. Given the success of examples such as the European Union Emissions Trading System (EU ETS) there is reasonable expectation that 3%-9% emission reductions can occur quickly (6). This policy type has lead to increases in RE when paired with financial incentives (11).

Cap-and-trade is a proven market-based instrument that empowers economic agents to make decisions regarding their emissions management strategies. Participants can opt to

purchase additional emission allowances or invest in emission reduction measures such as RE, energy efficiency initiatives, and sustainable practices. The market-driven setting of carbon prices further enhances efficiency by reflecting supply and demand dynamics (6). The risk of carbon leakage is a concern for Indiana economically.

The distributional impacts of cap-and-trade policies may disproportionately affect smaller businesses and fossil fuel-intensive industries, as they face greater challenges in transitioning to lower emissions profiles (5). Evidence from comparable regulatory instruments, such as the Clean Air Act, suggests that employment opportunities in affected industries may decline, resulting in potential income losses of up to 20% compared to pre-regulation levels (2). While health outcomes may improve with reduced GHG emissions, the extent of impact on the "1000-ton rule" hinges on the specific emissions cap set by the policy.

Implementation of a cap-and-trade system is likely to be more cost and time-effective compared to the status quo. Its market-based approach enhances its political feasibility, as it aligns with prevailing economic principles and may garner support from policymakers. However, fossil fuel-driven industries don't benefit posing challenges for policy adaptation. Indiana's pace of adoption may be influenced by economic considerations relative to neighboring states or those with similar economic profiles (2).

Energy Efficiency Regulation

Setting standards are a powerful option for policy. One method that this can be done is through energy mix. In using a Renewable-Energy Portfolio Standard (RPS) based regulation energy utilities are required to source a set amount of energy from RE, though there are many options to implement regulation (9). Another option is to set standards on emission rate for various equipments and products used in society. Think of examples such as automobiles, factories, and even light bulbs. This option offers a flexible framework for reducing GHG with multiple implementation options.

Regulations contribute to improving social surplus by incentivizing emissions reductions and fostering innovation within the market. This approach encourages competition among the market's agents, as stringent regulations prompt investments in cleaner technologies and production processes (2). Market-based methods, such as RPS, have demonstrated efficacy in increasing RE adoption and mitigating GHG emissions, while also minimizing negative externalities associated with conventional energy sources (11).

The impact of regulation policies is equitable across businesses, albeit certain industries may experience more significant adjustments. However, regulation initiatives have the potential to foster collaboration and partnership among businesses, enabling knowledge sharing and technology transfer. Employment prospects are expected to benefit from the gradual transition as businesses invest in efficiency measures rather than rapid structural changes (2). Research indicates that policies like RPS can substantially boost employment rates, particularly in sectors aligned with RE (16). While short-term health outcomes may improve due to reduced GHG emissions, long-term success hinges on implementing complementary transition-based solutions alongside regulations to ensure sustained environmental and health benefits (4).

This policy enjoys a higher likelihood of political acceptance as compared to other policies as it empowers businesses while fostering innovation (9). It is also cost and time effective to implement, though ongoing administrative costs could rise to enforce regulations (3).

Low-Carbon Technology Investment

This policy succeeds in fostering a supportive environment for low-carbon solutions to thrive within the market. Grants and subsidies have been shown to rapidly increase RE use (11). In 2022 alone, RE expansion led to 1 GtCO2 reductions though there have been diminishing returns as more policies are adopted (6 ;11). The effectiveness is also defined by how it is able to supplement and carry the energy demand for the region (3). In this policy option there is no improvement in the information asymmetry.

The policy offers significant efficiency gains by incentivizing investments in RE, thereby stimulating innovation and market growth. This policy can drive adoption by both producers and consumers, particularly when paired with mechanisms such as feed-in tariffs and premiums that subsidize RE use at a respectively fixed and variable rate (11). These investments hold the potential to offset varied regulatory costs, optimize energy availability, and drive down costs (2;9). With these positives, there does remain some skepticism regarding whether direct investment alone can sufficiently catalyze market adoption without additional incentives (3).

From a financial standpoint, the policy offers equitable benefits to all businesses. It provides opportunities for both established entities and entrepreneurs to capitalize on RE investments. Given the dominance of fossil fuels, support for RE research and development could enable companies to develop more robust solutions (11). Furthermore, the policy stands out for its straightforward benefits to employment, adding up to 402 direct net of jobs if RE completely overtook fossil fuels in Indiana (13). While health benefits may not immediately occur, the eventual decarbonization facilitated by increased RE adoption promises long-term public health improvements (4).

The policy presents a time-effective though moderately costly option for state implementation. Political feasibility may be constrained by the prevailing support for coal and natural gas entities among Indiana policymakers. Nonetheless, recognizing the imperative of sustainable energy supplies for long-term economic success is a valuable consideration. Possibly redirecting funds towards energy manufacturers and heavy emitters could serve as a pragmatic strategy to support their transition towards low-carbon technologies (3).

Fossil Fuel Phase Out into a Corporate Death Penalty

While this policy may yield limited short-term effects, its true potency lies in its long-term potential to significantly reduce GHG emissions by phasing out fossil fuel reliance completely. Its success hinges on the readiness of a low-carbon energy sector to fill the void left by coal and natural gas. Stringent policies have demonstrated efficacy in driving RE adoption, suggesting that the policy could pave the way for substantial emissions reductions over time (6).

Introducing a policy with such substantial legal ramifications could serve as a powerful incentive for swift action. There is the potential of great social loss if companies aren't able to adopt quickly enough. How much compared to the loss climate change will bring remains in

question. If companies were able to quickly shift their operations then this could open up new markets, though it is more likely to be very costly to current markets for both producers and consumers.

Fossil fuel-intensive companies would bear the brunt of the financial impact, potentially leading to widespread job losses. However, this disruption could create opportunities for new businesses poised to thrive in a low-carbon economy, potentially mitigating the temporary employment effects. The policy's focus on phasing out fossil fuels holds promise for improving health outcomes and holding emitters accountable, aligning with the imperative to address the "1000-ton rule" (4; 12).

This is a very costly policy, as it may warrant introduction of focused agency on the enforcement of it. It would require considerable time of not only administrations but also the judicial arm of government. It is unlikely that a policy such as this would gain much traction in Indiana. However, a small step towards a policy such as this may be to ban advertising for fossil fuel industries that violate emission limits similar to smoking policies (12).

Recommendation

Ultimately there are many viable options, none without their own challenges to overcome in the political landscape of Indiana. However effective a policy may be to the health and well-being of current and future citizens has to be mindfully considered against tue urgent need to gain momentum towards improving the energy landscape however gradual. Given that ‘Indiana Works’ is the state motto, any policy that even temporarily reduces jobs or risks to economic efficiency is unlikely to gain much traction. The Carbon Tax, Energy Efficiency Regulation, and Low-Carbon Technology all support these facets of the state’s ethos.

The Carbon Tax is very effective in many ways especially when the tax recycling is done effectively to support high emitting companies in their transition. Even with that in mind, Indiana is conservative in its energy policies and this is a nascent, yet growing, policy recommendation worldwide.

That leaves a pair of policies that could be quickly adopted by Indiana to improve its energy landscape. Setting regulations alongside investing in low-carbon technologies lifts the bottom floor of emission problems while setting the foundation for a transition to low-carbon energy production and usage to come from within the market. These two policies in tandem will improve health outcomes slowly. Hopefully, over time more overall effective policies will be more viable in Indiana.

Although this recommendation is provided by sound analysis, gaps exist in its evaluation. It is recommended that further assessment is done with the inclusion of infrastructure construction as an aspect in effectiveness criteria as well as both earned income and training for the employment aspect of equity.

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