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Article

Global Solutions & Outreach Programs: Humanity's best chance to resolve global warming, Part 2: Global warming solutions

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Abstract: In "Global Solutions & Outreach Programs: Humanity's best chance to resolve global warming, Part 1: Global warming challenges," we discussed the challenges that are preventing humanity from resolving global warming. We are facing an existential threat. To mitigate these biases, the Global Solutions and Outreach Programs (GSOP) proposal calls for a truly global collaboration to evaluate and integrate climate solutions using the wicked-problem approach. This approach was demonstrated in the 1990s by a U.S. Army-funded project led by Dr. Richard (Dick) Hutchinson. The project involved two hundred and seventy (270) professionals from national laboratories and other U.S. government agencies to provide effective verification measures at the international chemical weapons convention then being negotiated in Geneva. GSOP evaluation and integration of climate solutions will be undertaken by multiple teams of engineers, economists, social experts, and political experts within each country. This work will be done outside of, yet informing, governments, the marketplace, and public opinion. Country Action Plans will be rolled up to regional and global levels. The GSOP work will be iterated until the global action plan provides a resolution of global warming at the scale of Earth. Part 2 describes our GSOP proposal.

Keywords: global warming; climate change; climate solutions; wicked problems; business-as-usual; collaboration

1. Summary of part 1: Global warming challenges [1]

Over the past few centuries, humanity has constructed two frameworks that in combination have powered economic growth: large capital investment stimulated in great part through stock markets, and government support through stimulus funding and tax policies. Those making decisions in these areas lack expertise in climate solutions and therefore must depend on advice from others. We argued that such advice is biased, identifying those bias types as corporate vested interests, career vested interests, public passions (advocacy), and political agendas. We must do our best to mitigate the influence of these biases in climate solution decisions.

Four global projects are now humanity's best hopes to resolve global warming: Annual COP meetings, the Deep Decarbonization Pathways Project [2], Project Drawdown [3], and the IEA Net Zero by 2050 Roadmap [4]. Thousands of well-intentioned people are working within these initiatives. Even so, progress is woefully inadequate. Human biases, albeit understandable and intrinsically harmless on their individual merits, in combination exert a detrimental influence on the work of these initiatives.

We provided the results of two surveys taken at our website—on the detrimental influence of human biases, and the effectiveness of global collaboration to resolve global warming. Considerable concern was expressed about both biases and collaboration. Our GSOP proposal will provide a structure that will mitigate biases and provide for true global collaboration.

We discussed planetary limits and intersecting issues that have not been adequately addressed in global initiatives: Critical minerals [5,6], the likelihood of a financial tipping point arising from declining global GDP due to the damaging effects of climate change, threats to food sources [7,8], and the time we have remaining to resolve our existential problem [9].

Our GSOP proposal will provide the most efficient means of addressing all these challenges.

2. Part 2: Global warming solutions

2.1. Introduction

Even though many well-intentioned people are working around the world to resolve global warming and address climate change via adaptation, humanity is making limited progress in doing so. On 9 December 2024, Dr. James Hansen, Director of the Program on Climate Science, Awareness, and Solutions at Columbia University's Earth Institute, released a statement to the International Court of Justice [10] in which he focused on the failure of humanity to resolve global warming making this profound statement: "There is no plan to actually stabilize climate." Global Solutions and Outreach Programs (GSOP) will provide humanity with country, regional, and global action plans to best resolve global warming both expeditiously and responsibly.

GSOP will face the problem realities and overcome the challenges and impediments to progress reviewed in Part 1. These realities and challenges drove the GSOP plans. This is not an arbitrary creation; it results from necessity.

The Global Solutions and Outreach Programs presented here are the culmination of ten years of work beginning with Hutchinson's "People's Assessment of Global Warming, Plus Adaptations for Advancement and Survival" [11], then expanding with Rehm's plans for a climate collaboration outreach program, and finally refining and expanding further to a global program involving all countries of the world. The programs utilize the wicked-problem approach to gain honest, practical global warming solutions at country, regional, and global scales.

In summary, much remains to be done to successfully address the super-wicked problem of global warming. The GSOP is our proposal to fulfill this need.

2.2. Global solutions & outreach programs (GSOP) summary

The GSOP consists of a Global Solutions Program, which is structured in three People's Projects. We call them People's Projects because the people must be involved, and everyone will be impacted by the results. The Outreach Program will closely link with the Global Solutions Program and provide engineering support to ongoing country climate change initiatives. Each country will have its own GSOP to ensure

that local factors are addressed and to arrive at action plans that best suit local conditions. All country GSOPs will be centrally funded for their efforts.

Here are the GSOP global program goals: Develop country, regional, and global action plans to guide future work by each country, each region and globally to successfully overcome global warming. To do so, the country plans must work together to achieve net zero CO2 release, adapt to climate-change impacts, stabilize and adjust the Earth's energy balance, and address other problems such as ocean acidification and methane release, all at the scale of Earth. The Global GSOP will also provide engineering support to ongoing climate-change efforts and provide national and international collaboration to focus a vast array of minds on solving the global warming problem.

The GSOP global end-state goals are to implement the action plans to successfully overcome global warming, and, thereby, to allow civilization to survive and thrive.

GSOP will require four years, a startup year followed by three years of analyses and generation of viable action plans. By necessity, GSOP must be an international, global effort with experts from all countries participating. It cannot be successful on a piecemeal basis, as the Earth is one integrated system.

Each nation will have their own GSOP. Collaboration between countries will be conducted mainly through the internet with periodic in-person meetings to facilitate collaboration.

2.3. GSOP program and execution plans

These plans aim to provide an understanding of the GSOP, how it will be executed, and how the pieces fit together. These plans include the problem diagram, personnel plan, administration and start-up year plan and the cost plan. The plans are scaled to the US and constitute the US baseline plans. GSOP teams in each country will scale the US baseline plans to their level of funding and to best meet their local conditions and needs. These plans are followed by the Global Cost Plan, the US Global Support Center, and the Global Schedule. We begin with a summary of the GSOP problem diagram, which is our detailed 20-page proposal provided on our website [12].

2.4. GSOP problem diagram

The problem diagram Schematic, as shown in **Figure 1**, is essentially a thumbnail view of a problem diagram. It includes project and end-state goals, problem elements and solution work units. The problem elements break the global warming problem into technical, economic and social/political problem elements. The solution work units, analogous to a statement of work, present the efforts needed to overcome the problem elements.

In the following, for each of the three GSOP People's Projects and for the Outreach Program, we show the Tier 1 project and end-state goals and a summary of Tier 3 solution work units. The work units are analogous to a statement of work. For brevity, we do not include the Tier 2 problem elements.

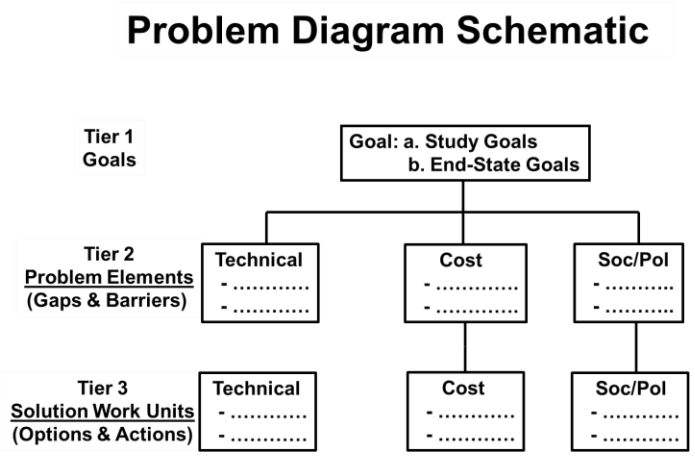

Figure 1. Problem diagram used to define the wicked-problem approach problem-solving effort.

2.5. GSOP people's project 1

Goals: Project goals include identifying, evaluating and integrating all available options to halt net CO_2 release and adapt to unavoidable climate-change impacts by the years 2050, 2075 and 2100. In this way, participants can see the time dependence of the costs to achieve the goal, versus the costs of dealing with climate-change impacts. The People's Project 1 end-state goals are the same as the GSOP global goals: to implement the action plans to successfully overcome global warming, and thereby to allow civilization to survive and thrive. Project 1 will be executed by teams within each country.

Solution work units: An organization team will facilitate and lead the Project 1 teams in each country. Since the GSOP will be a global effort, a standardization and internal reporting team in each country will collaborate internationally to agree on units and terminology, and to share information among all countries.

Technical teams comprised of engineers and subject-matter experts will evaluate the many available options to halt net release of CO_2 and adapt to unavoidable climate change impacts. A partial list of over 140 options is provided as a starting point for evaluating options in People's Projects 1, 2 and 3. The list is divided between the three People's Project areas. These teams will also work to identify and evaluate any other available options, using the latest data and research for such options, that are not now on our partial list of options. Options evaluated will include those supported with government funding and those supported privately or commercially. Technical evaluations will address the following criteria: technical feasibility and readiness; effectiveness in meeting project goals; integration problem and solutions; environmental impacts; personnel and community safety; scale, timing and locations of implementation; capital, operating and total yearly costs; timing of implementation; net energy requirements, human, natural, and water resource requirements and availability, including mineral limitations.

Integration and internal reporting teams within each country will integrate the many options from People's Projects 1, 2 and 3 into systems of climate solutions to meet all of the project goals. The results of economic and social/political evaluations of the country's climate systems will then be combined into Country Action Plans to

ensure that the plans are technically feasible and effective, economically supportable, and socially/politically acceptable. The action plans will include approaches for implementing the optimal global warming solutions for each country, each region, and globally. The team will also identify and resolve integration issues. The Integration and Internal Reporting Team, along with the economics and social/political teams, will draft Country Action Plans to address global warming and will prepare other periodic reports of progress.

Social/political teams will obtain state/province, local community and industry evaluations of the social/political acceptability of solution options, and assess the social/political acceptability and barriers of integrated systems. These teams will determine how social/political barriers can be overcome to successfully achieve the best practical integrated systems, and will assist in drafting Country Action Plans to address global warming.

Country economics teams comprised of economists will evaluate the total climate system's costs and devise ways to support these costs, taking into account the country's economic situation. These teams will assist in drafting Country Action Plans to address global warming.

Members of these three national teams will also serve on corresponding regional and global teams to produce regional and global action plans to meet all GSOP goals.

2.6. GSOP people's project 2

Goals: Project goals include identifying, evaluating, and integrating available options to stabilize and adjust the Earth's energy balance to halt further warming and return to acceptable conditions, and to deal with ocean acidification and other problems including methane release by the years 2050, 2075, and 2100. The goals of Project 2 are global in nature and will require collective efforts—thus the need for international teams. The People's Project 2 end-state goals are the same as the GSOP global goals. Project 2 will use international evaluation teams comprised of people from each country's People's Project 2.

Solution work units: An organizational team will facilitate and lead the Project 2 teams in each country. Standardization and internal reporting will be handled by the People's Project 1 team.

International technical teams comprised of engineers and subject-matter experts from each country will evaluate the many available options to meet People's Project 2 goals using the partial list of options as a starting point. These teams will also work to identify and evaluate any other available options, using the latest data and research for such options, that are not now on our partial list of options. Options evaluated will include those supported with government funding and those supported privately or commercially. They will evaluate the options using the same technical criteria as for People's Project 1.

An international coordination & internal reporting team will assemble results from international teams working on each option and prepare internal summary progress reports quarterly. The team will also serve as a global point of contact for coordinating Project 2 efforts.

Integration of options, economic, and social/political tasks will be handled in

each country's People's Project 1.

2.7. GSOP people's project 3

Goals: Project goals include identifying ways to accurately monitor and model the Earth's energy and CO_2 balances and to project future conditions; identifying, evaluating and prioritizing technologies currently in R&D to meet the objectives of People's Projects 1 and 2, and supporting and promoting international cooperation to test and develop the best R&D options. The People's Project 3 end-state goals are the same as the GSOP global goals. Project 3 will use international evaluation teams comprised of people from Countries' People's Project 3.

Solution work units: An organization team will facilitate and lead the Project 3 teams in each country. Standardization and internal reporting will be handled by the People's Project 1 team.

An international climate monitoring, models and future conditions team comprised of engineers and subject-matter experts from each country will identify ways, available models and available data to monitor and project the Earth's energy and CO_2 balances, and ocean levels. Using these, the team will develop user-friendly engineering models of the earth's energy and CO_2 balances, and ocean levels. These models will be used to support the technical evaluation of each option in meeting GSOP goals that include halting the net release of CO_2, coping with climate change impacts, stabilizing and adjusting the Earth's energy balance, and addressing other problems including ocean acidification and methane release.

International technical teams comprised of engineers and subject-matter experts from each country will evaluate R&D options to meet People's Projects 1 & 2 goals using the partial list of options as a starting point. The teams will also work to identify and evaluate any other advanced R&D options, using the latest data and research for such options, that are not now on our partial list of options. Options evaluated will include those supported with government funding and those supported privately or commercially. They will evaluate the options using the same technical criteria as for People's Project 1.

An international coordination & internal reporting team will assemble results from international teams working on each option and prepare internal summary progress reports quarterly. The team will also serve as a Global Point of Contact for coordinating Project 3 efforts.

Integration, economic, and social/political tasks will be handled in each country's People's Project 1.

2.8. GSOP Outreach Program

Outreach Program goals include providing engineering support and advice to states/provinces, local communities, and industries that are taking action on clean energy, CO_2 reductions, improved efficiencies, adaptations and other global warming solutions. It will interface closely with the Global Solutions Program to provide a two-way flow of information and collaboration between states/provinces, local communities, and country levels to achieve a broad and powerful focusing of many minds. The Outreach Program's end-state goals are the same as the GSOP global goals.

The GSOP Outreach Program will be executed by teams within each country.

Solution work units: An organization team will facilitate and lead the Outreach Program teams in each country and will consolidate results from the state/province teams.

State/province teams in each country will interface with communities and industry, and engage with diverse sectors, thereby enabling a more inclusive and holistic approach to global solutions. It will provide engineering support to local communities, industry, and states/provinces in their work on global warming. state/province teams will recruit engineers working in each country's sectors and request that they review the integrated country climate systems, provide their assessment of sector impacts, and propose sector accommodations to resolve sector impact issues, including mineral limitations. The teams will also prepare internal summary reports for each state/province quarterly, and will obtain social/political evaluations of options and integrated climate systems in coordination with People's Project 1 social/political teams.

Figure 2 explains how the GSOP will work. Teams of engineers from each country will work on country climate solutions to meet Project 1 goals. International teams will rigorously evaluate available and R&D options for feasibility and effectiveness in meeting Project 1 and 2 goals. The Outreach Program will also provide social/political evaluations of solution options and systems.

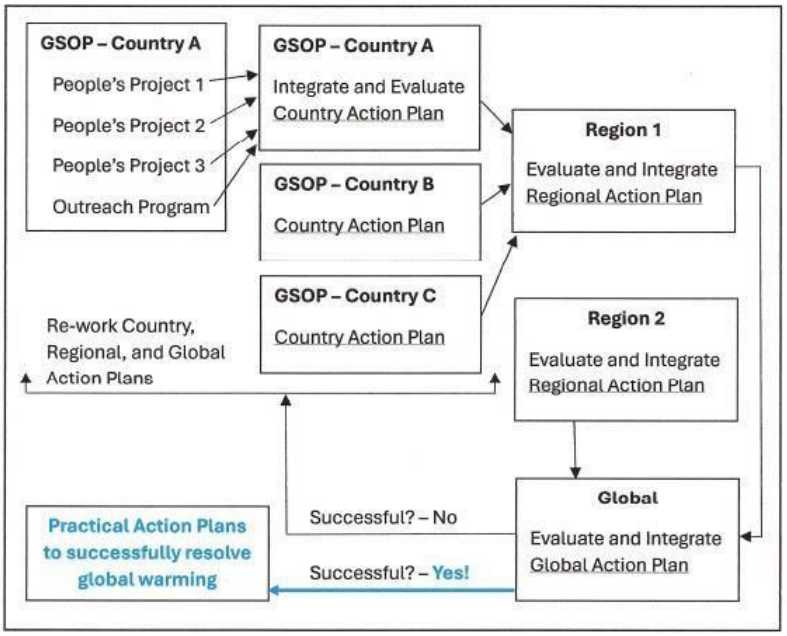

Figure 2. Iterative international evaluation and integration of global warming solutions will continue until global success is achieved.

The overall products of People's Projects 1, 2 and 3, and the Outreach Program are country, regional, and global action plans. It is only at this point that GSOP participants can see if the country and regional action plans will add up to successful global solutions.

To be successful, the global action plans must solve global warming at the scale of Earth and on Earth's physical terms. The plans must also be successful on human

terms of economic achievability and social/political acceptability.

If the global action plans are not successful in meeting these goals, then the entire process must be repeated (iterated) by going back and revising the country plans until the Global Action Plan will successfully overcome global warming. In this way, each country will be in charge of its Country Action Plan, while achieving overall global success by working together. With these repetitive iterations of climate solution evaluations and integration, everyone will know what must be done to resolve global warming. We will go from false hopes about our favorite climate solutions, and false confidence in current market practices, to confidence that we can solve our planetary problem. This iterative approach is depicted in **Figure 2**.

2.9. GSOP personnel plan

The GSOP Personnel Plan is based on the GSOP problem diagram and associated Solution Work Units to execute the GSOP, which we refer to as "GSOP operations." We have estimated the numbers and types of personnel needed to accomplish each work unit in the problem diagram. There are three types of GSOP personnel positions that need to be specified: problem facilitators, full-time personnel, and part-time personnel. Problem facilitators must be full-time to coordinate and assist their teams and are included in the full-time staffing numbers. Part-time staff will work 4 h per week (one-10th of full time). The numbers of full-time co-located personnel are also estimated.

Personnel totals for US baseline GSOP operations are shown in **Table 1**.

Table 1. Personnel totals for US baseline GSOP operations

Personnel Types	**Personnel Numbers**
Engineers	366 full-time and 2648 part-time
Economists:	7 full-time and 20 part-time
Social/political experts:	7 Full-Time and 20 part-time
Subject matter experts:	2 full-time and 302 part-time
GSOP totals:	382 full-time and 2990 part-time
Problem facilitators:	346 full-time
Co-locate:	100 full-time

2.10. GSOP administration support and start-up year plan

This plan provides the tasks, personnel, and cost estimates to start up and provide the needed administrative support during the three years of GSOP operations. GSOP operations refers to the teams and efforts to execute the 3-year GSOP in each country. In this way, the operations teams can concentrate on performing the work of the solution work units, and solving the global warming problem. Administration support is a part of each country's GSOP.

A GSOP start-up year is required before the three years of GSOP operations. During this year, an administration support team must be established and staffed in each country. The team must hire a small operations start-up team that will serve as a nucleus to quickly begin GSOP operations the following year. The administration

support team will recruit, hire, and pay all operations personnel, and handle country GSOP finances throughout the programs.

A total of 23 full-time personnel is required for the US Administration Support Team. Administration support for the start-up year and for the 3 years of GSOP operations will cost 3.25 million US dollars (USD) per year and total 13 million USD for the 4 years.

2.11. GSOP US cost plan

The United States cost plan is based on the numbers of full-time and part-time personnel specified in the GSOP Personnel Plan for GSOP operations. The cost of administration support and start-up year costs are included in the administration support and start-up year plan.

The full-time salary for GSOP operations personnel is 129,000 USD/year which is based on an average chemical engineering salary of 122,000 USD/year plus a 5% incentive for accepting GSOP term positions. A 40% overhead rate is added to each full-time salary and results in a full-time labor cost of 180,600 USD/year.

The annual salary for part-time participants working 4 h/week (one-10th time) is 12,900 USD/year. A 20% overhead rate is added to each part-time participant, resulting in a part-time participant labor cost of 15,500 USD/year.

Applying these labor costs, the total cost of the 382 full-time and 2990 part-time operations personnel for 3 years is 363.1 M (million) USD. The cost of administration support plus the start-up year is 13.0 M USD. Combining these figures results in a total US GSOP cost of 376.1 M USD.

2.12. GSOP global cost plan

The global cost plan provides estimates of GSOP costs and manpower for each country around the world. It is based on detailed US GSOP Baseline Plans that include the GSOP problem diagram, personnel plan, administration support and start-up year plan, and cost plan. The global cost plan, presented in an Excel spreadsheet, scales the US baseline figures for different-sized countries. It provides a way to move forward and gives every country a meaningful way to budget their own GSOP. **Table 2** summarizes the global cost estimates for each region.

The ratio of each region's Gross Domestic Product (GDP) to the US GDP is listed in column C. US baseline costs are multiplied by these ratios for the initial estimate of GSOP costs for each region, column D. After seeing the initial results in column D, we quickly saw the need for adjustments.

The initial GSOP cost estimates for South America and Africa (in column D) are far too low given their populations and area. Even in Europe costs were less than in the United States. We addressed this situation by setting the regional baselines for South America, Africa and Europe equal to the baseline figures for North America, thus treating these four regions in an equal way. We raised the funding and staffing levels of Oceania to 30% of the US baseline figures. In light of the high population of China and Asia, and their high GDPs, we set the baseline for China equal to that of the United States.

When we viewed these results, we noted that some small countries with small

GDP ended up with almost no GSOP staff or money. To correct this untenable situation, we made a final revision by setting a minimum operations staffing level for each country of 2 full-time engineers, 2 part-time economists, 2 part-time social/political experts, and 4 part-time subject-matter experts. All of the GSOP Regional Final Revision Columns E, F and G include these minimum staffing levels. Administration support staffing and costs were also adjusted. The total cost of the Global GSOP as shown in **Table 2** is 3096.2 million USD, rounded to 3.1 billion USD.

The global cost spreadsheet has many more columns than shown in **Table 2**, and includes detailed personnel estimates. The global number of GSOP participants totals approximately 2800 full-time and 22,200 part-time engineers, economists, social/political experts, and subject-matter experts.

Table 2. World summary of GSOP costs showing total regional costs and total global costs.

A	**B**	**C**	**D**	**E**	**F**	**G**
World regions	**GDP, Billion USD**	**Region GDP/US GDP**	**Initial region GSOP total cost, M USD**	**Final region GSOP operations cost, M USD**	**Final region GSOP admin & start-up year cost, M USD**	**Final region GSOP total cost including start-up year, M USD**
US baseline	25,463		376.110			
Regions						
Africa	2947	0.116	44	456.6	75.5	532.2
North America	30,235	1.187	447	472.3	46.4	518.7
South America	4213	0.165	62	433.2	29.1	462.3
Asta	95,889	1.409	530	753.4	75.4	628.7
Europe	25,046	0.984	370	465.5	74.5	530.9
Oceania	1987	0.078	29	133.6	20.9	154.5
World totals:	100,311	3.939	1482	2714.5	321.8	3036.3
					US Global Support Center, M USD	52.7
					US Global Support Canter Set-Up, M USD	7.2
					Total Globel GSOP Cost, IM USD	3096.2

Round global GSOP total cost 3.1 B USD: Global start-up year cost of 0.1 B USD, plus and GSOP 3-year execution 3.0 B USD.

We believe that this estimating strategy is objective and rational. Larger countries with large GDPs generally have high levels of industrialization and have released more CO2 than countries with lower levels of GDPs. As a result, countries with high GDPs have much work to do to overcome global warming. All GSOP assessments will be shared with all countries through the internet to the benefit of both large and small countries.

2.13. US global support center

The US Global Support Center will resource and support GSOP in all countries once funding is secured. The Center will also provide coordination and oversight

necessary to enable all countries to succeed and to achieve overall global success. The center must be fully staffed and ready to function at the beginning of the global start-up year. Thus, the center itself must be set up during the year prior to GSOP global startup. **Figure 3** shows the structure of the US Global Support Center.

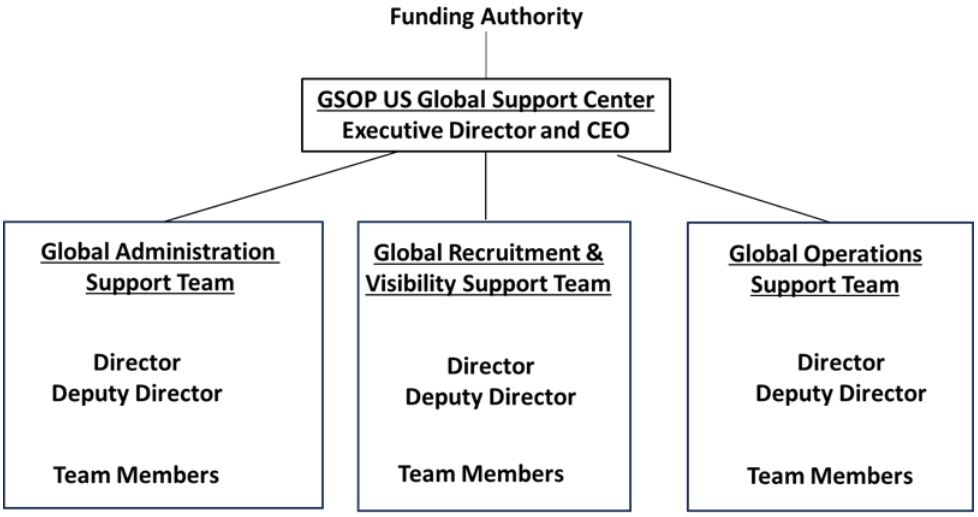

Figure 3. A schematic of the four parts of the US global support center.

The executive director and CEO will interact with the funding authority to secure funding for the Global Support Center and to resource GSOP in all countries. He/she will provide quarterly updates to the funding authority, render oversight of and support to the three team directors, and interface with the GSOP Global Technical Advisory Committee to obtain their independent advice.

The global administration support team will handle all administration, personnel, financial, and legal support functions of the US Global Support Center. The team will ensure via approval that GSOP nonprofit organizations are established in accordance with each country's legal requirements. The team will prepare and implement country guidelines, procedures and periodic reporting requirements on handling GSOP funds and staffing, and will conduct country audits as needed.

The global recruitment & visibility support team will recruit candidates for the Global Support Center, for each country's administration support director/deputy, for each country's operations start-up team, for one engineer from each of the 6 world regions to serve as a regional liaison, and for a GSOP Global Technical Advisory Committee of senior experts and advisors. The team will initiate GSOP in each country by advertising GSOP job positions for engineers, economists, social/political experts, subject matter experts, and administration support directors.

The team will establish & maintain global GSOP visibility activities, prepare and distribute external GSOP global progress reports to periodically inform the public, government officials, and GSOP sponsors of progress. The team will engage with policymakers at the international level and with institutions now working on global warming and climate solutions, e.g., IPCC, UNFCCC, COP meeting leadership, Project Drawdown, Deep Decarbonization Pathways Project, and IEA. They will establish and maintain a GSOP global website, and prepare and maintain a database of GSOP global progress reports.

The global operations support team will review applications and select each country's Operations Start-Up Team staff. The team will train the country operations start-up teams on the wicked-problem approach and GSOP. A wicked-problem approach training program has been prepared, consisting of six two-hour sessions with a one-hour lecture, including question-and-answer breaks, followed by a one-hour class exercise to develop plans to solve a wicked problem of their choice. They will train and assist each start-up team to scale the GSOP US baseline plans to their country's level of funding and priorities. The team will review applications for project-level problem facilitators in each country and concur in the selection before the candidate is hired. The information technology expert will start planning a GSOP Global Internal (internet-based) Report Platform.

The US Global Support Center will have a total staffing of 79 full-time personnel, and will cost 7.2 M USD for set-up and 52.7 M USD for its 4-years of global support.

2.14. GSOP global schedule

The global schedule covers five years. Executing the GSOP will require three years to complete. Starting up GSOP in all countries in the same time frame will require one start-up year. The US Global Support Center must be set up the prior year. An overall GSOP schedule is presented in **Figure 4**.

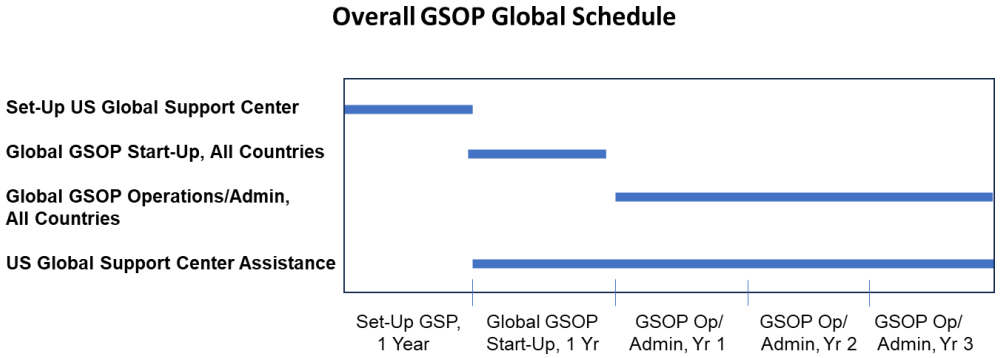

Figure 4. Schematic of overall GSOP global schedule including the two preparatory years and the three years to execute the GSOP.

The first task is to set up the US Global Support Center. The Support Center will provide GSOP funding and other support to the GSOP teams in each country. It is responsible for starting up GSOP in all countries during the global GSOP start-up year. To meet this requirement, the Support Center must be set up and fully staffed prior to the global start-up year.

The global start-up year will allow each country to establish and staff their administrative support teams before Year 1 of GSOP execution begins. Each country will also staff a small GSOP operations start-up team to receive training on the wicked-problem approach and scale their GSOP based on their country's funding level. ("GSOP operations" refers to accomplishing the GSOP tasks, and to the associated teams.) Operations teams are paid and supported by the "GSOP administration support" teams.

Execution of the GSOP in all countries will begin with staffing of GSOP

operations teams and commencing the GSOP work in GSOP Year 1. GSOP operations with administration support will continue through GSOP years 2 and 3. The US Global Support Center will continue to provide funding and support to the country GSOP teams throughout the programs. During the 3-year GSOP execution, climate-solution options will be evaluated and integrated multiple times to arrive at the best solutions that are technically feasible and effective, economically supportable and socially/politically acceptable.

2.15. Wicked-problem approach & GSOP

As mentioned earlier, the GSOP will utilize the wicked-problem approach to solve the wicked problem of global warming. A six-session wicked-problem approach training program and student handbook will be given to the operations start-up team in each country during the start-up year. Start-up team members will then train other problem facilitators and full-time staff using a train-the-trainer approach. While avoiding training details, we will now explain how key factors of the wicked-problem approach are embedded within the GSOP plans. **Figure 5** lists the key factors of the wicked-problem approach.

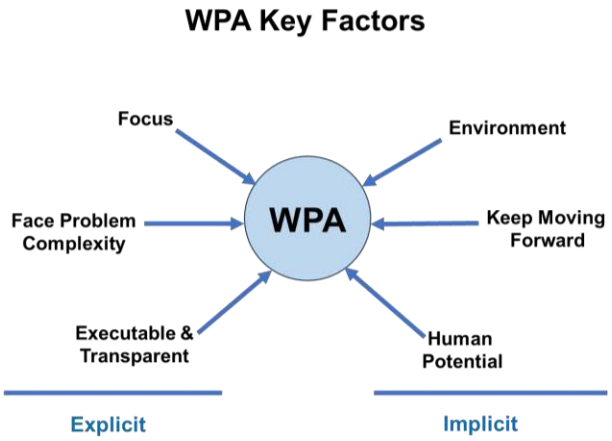

Figure 5. The six key factors of the wicked-problem approach embedded into the GSOP.

These factors fall into two broad groups. “Explicit” factors are those that can be achieved with specific actions that are built into the Wicked-Problem Approach. Other key factors are “implicit” in that they relate to human feelings and reactions. For example, people work best when they are highly motivated. Creating a supportive environment can help motivate people, but the people themselves must feel motivated. The most important implicit factor is tapping the full human potential. It is the overarching purpose of the wicked-problem approach. The other implicit and explicit factors contribute to achieving this key factor. Achieving the explicit and implicit factors is described below.

Focus: Focus is crucial if people are to work together and achieve common goals. The GSOP problem diagrams contain explicit project goals and end-state goals to provide a common focus. The goals require solutions that are technically feasible and effective, cost-affordable, and socially/politically acceptable in order to be implemented and actually resolve the global warming problem. In other words, the

solutions must be effective and practical, with adequate being okay.

Within the GSOP problem diagram, problem elements and technical work units are divided into technical, economic and social/political factors. This standardized structure used by all participants contributes to the common focus.

Lastly, by starting up GSOP in all countries at the same time and proceeding on the same schedule, everyone is on the same learning curve. Sharing and integration of results, and focus are all enhanced. International collaboration between GSOP in all countries can begin immediately.

Face complexity: We must face the complexity of wicked problems if they are to be solved. In the problem diagram, we explicitly divide the problem into technical, economic and social/political problem elements and corresponding solution work units so that these key parts of wicked problems are explicitly addressed, not ignored.

We let the problem drive the solution by first identifying the problem elements of the global warming problem and then by selecting solution work units needed to address each problem element. In this way, participants face problem complexity head-on.

Executable & transparent work units: Solution work units must be executable by the participants if they are to be of any value. Therefore, the personnel assigned to each solution work unit must have the skills needed to perform that work unit. In the GSOP, engineers will evaluate and integrate options, economists will make economic analyses, and social/political experts will gather and analyze public opinions that will aid the GSOP work. They will have the requisite skills for their tasks. Other subject-matter experts will be hired as needed.

Problem-solving environment: Now, let's turn to the three more implicit factors starting with the problem-solving environment. An ideal environment encourages, motivates and assists.

(1) Relying on bottoms-up problem-solving supports this environment. GSOP problem facilitators don't direct, but rather they lead and assist. They rely on participants' self-discipline and commitment to accomplish the needed tasks. All participants are treated equally and paid equally around the globe.
(2) A learning environment stimulates creativity and motivates people. Starting all GSOP efforts together places everyone on the same learning curve and initiates learning from the start. Evaluating all options on technical, economic and social/political aspects will require learning.
(3) People work best when they are free to focus on facts and truth, not opinions. GSOP Problem Facilitators will encourage truth-based problem solving.
(4) GSOP Problem Facilitators are trained to be sensitive and open to good ideas from any participant at any time. Valuing the input of all participants is a motivator. And, as we have seen first-hand, good ideas can be key to actually solving a wicked problem.

Forward progress: Participants are encouraged and motivated by a sense of forward progress and accomplishment—they must keep moving forward.

(1) To do so requires working through confusing periods. Confusing periods must be expected, given the wicked problem's many tangled factors. Some have described the wicked-problem approach as "controlled chaos." Starting GSOP in all countries together may add to the initial chaos. From our experience, people will

work through it and form a cohesive effort. GSOP Problem Facilitators are trained to expect confusing periods and to encourage everyone to "keep pulling on their oars." Over time the fog will clear.

(2) Relying on an iterative approach and continuous learning allows for partial success the first time through, and further success on subsequent iterations. Iterations are built into the GSOP execution schedule and tasks.

(3) As previously noted, we have included executable Solution Work Units in the GSOP problem diagram that can be accomplished and allow for forward progress.

Full human potential: When we talk about tapping the full human potential, what do we mean? Human potential certainly includes human creativity, rational analysis, and hard thinking. But it also includes all the vague and varied abilities that individuals apply to difficult tasks.

The wicked-problem approach is not a "methodology" where you work through a defined series of steps, or engineering calculations, and out pops the answer. Rather it is an "approach" to focus both small and large groups of people on common goals and provide them with opportunity to apply their full human potential.

Here are key factors that are built into the GSOP to achieve this end:

(1) Bottoms-up problem solving so everyone can contribute and feel empowered.

(2) Create a learning environment to provide needed knowledge, breakdown barriers, and catalyze creativity.

(3) Be sensitive to good ideas so each person is heard and acknowledged.

(4) Treat all participants as equals with equal pay around the world to motivate and to attract the best and brightest to this most complex problem.

Bottom line: While the wicked-problem approach provides focus and environment, it is the application of human potential that solves wicked problems. GSOP problem facilitators will be trained to keep this principle in mind and to observe the results.

2.16. GSOP key results

Key results include the following:

- Country, regional and global action plans that will guide future work in all countries to successfully solve global warming, solving it on both Earth's physical terms and on human economic and social/political terms.
- Engineering support to states/provinces, local communities and industries to enhance their vital ongoing climate work.
- Extensive in-country and international collaboration that will build global consensus needed to implement the action plans.

These results will place humanity on a new path to successfully overcome global warming—a path filled with hope. We are very concerned that too many are losing hope. In September 2020, the Guardian published an article saying that young people are losing hope [13]. GSOP is a reason for hope.

We believe that the GSOP return on investment is nothing less than enabling humanity to survive and thrive! Survive by using effective, practical action plans to successfully overcome global warming. And thrive economically and socially/politically as countries mobilize and cooperate to implement the action plans.

Is a global investment of $3.1 billion too steep to resolve global warming? According to McKinsey & Company, $3.1 billion will need to be spent every three hours to achieve net-zero emissions by 2050 [14].

3. Conclusions: Global warming solutions

We have no other rational choice than to successfully resolve global warming on both Earth's terms and human terms to ensure the future well-being of our children and grandchildren, and the survival of modern civilization**.** Unfortunately, current ad-hoc, piecemeal, business-as-usual efforts to overcome global warming are not working for reasons outlined in Part 1 of this article. Atmospheric CO_2 levels, temperatures, ocean levels, and fossil fuel use all keep rising regardless of all of this work. We cannot continue on this path.

With the scale of Earth and the scope of modern civilization, global warming is a strategic super-wicked problem. This is the most complex and threatening problem that humanity has ever faced—making it both a strategic problem and a strategic threat. Strategic problems can only be defeated by mounting strategic attacks.

The Global Solutions and Outreach Programs offer a strategic attack. The programs are global. They will focus and link thousands of engineers, economists, social/political experts, and subject-matter experts in every country on common objectives for rigorous, fact-based assessments and collaboration. To the best of our knowledge, the GSOP is the only detailed, executable plan based on proven approaches that anyone has offered.

The GSOP work will be done at the scale of Earth with collaboration from all countries, over a three-year period. The GSOP budget is $3.1 billion. We consider this reasonable and necessary. Putting the GSOP budget into global context, according to McKinsey & Company, humanity must spend $1 billion per hour to achieve net-zero emissions through 2050 [14]. The return on investment, survival of modern civilization, would seem to justify the investment. The GSOP Management Team is actively seeking US and international funding for this global effort. We are also seeking smaller amounts for ongoing administrative costs and other preparatory work [15].

Our team includes GSOP co-founders Hutchinson and Rehm along with other engineers and specialists including Eric Townsend, Balaji RamaRao, and Bob Romero. We are now focusing on increasing awareness of our GSOP proposal around the world, fundraising, preparing GSOP program plans, and developing/piloting Wicked-Problem Approach training. We are not VIPs and do not have power, fame or wealth. All we have is our program proposal, rationale, and commitment. We believe that we understand global warming realities, and the catastrophic shortfalls of humanity's current path. These realities weigh heavy on us, motivating us to advance the GSOP as the only viable path forward. We are not seeking personal gain.

We need your help to ensure that the GSOP analyses will be done and then implemented:

- Help to expand our constituency to millions of young people and others worldwide.
- Help to reach and convince government decision-makers to provide funding.

- Help to reach and convince philanthropists and foundations to provide funding.

Our small team of volunteers is making progress in spreading awareness of our proposal. To promote Global Solutions and Outreach Programs, on 21 March 2023, we established the nonprofit GSOP Climate Collaboration, Inc., https://www.climate-collaboration.com. On 16 February 2024, an article appeared in the World Reporter [16]. On 25 October, an open letter with 127 endorsements was addressed to Antonio Guterres, Secretary General of the United Nations, and to John Podesta, United States Special Presidential Envoy for Climate. One hundred and twenty-eight engineers and subject-matter experts have expressed a desire to work on the GSOP once funding is available.

GSOP participants will embark on a great adventure: Mounting a frontal attack on the most complex and threatening problem humanity has ever faced. No one has the answers and there is no comparable effort–participants will lead the way! As a result, they will uniquely provide:

(1) A crucial resource providing a common understanding of:
   - The global warming problem and its effects.
   - Integrated solutions for each country, region and for the world—solutions that are technically feasible and effective, economically supportable and socially/politically acceptable.
   - The actions needed to implement the solutions at country, region and world levels.

(2) A vital capability to help implement the solutions with a shared sense of urgency and responsibility to act.

With these unique understandings and vital capabilities, the 2,800 full-time and 22,200 part-time engineers, economists, social/political experts, and subject-matter experts participating in the GSOP work from all countries and will become a force for change!

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References

1. Hutchinson RW, Rehm TE. Global Solutions & Outreach Programs: Humanity's Best Chance to Resolve Global Warming. Part 1: Global Warming Challenges. The Journal of Policy and Society.
2. Bataille C, Waisman H, Colombier M, Segafredo L, Williams J. The Deep Decarbonization Pathways Project (DDPP): insights and emerging issues. Taylor & Francis. Vol. 16, No. S1, S1-S6, DOI: 10.1080/14693062.2016.1179620
3. Hawken P. Drawdown: The Most Comprehensive Plan Ever Proposed to Reverse Global Warming. Penguin Books; 2017.

4. International Energy Agency (IEA). (2021). Net Zero by 2050: A Roadmap for the Global Energy Sector. Paris: IEA.
5. International Energy Agency (IEA). (2021). The Role of Critical Minerals in Clean Energy Transitions. Paris: IEA.
6. Michaux, S.P.2023 Feb. Material Supply Challenges for the Green Transition to Phase out Fossil Fuels. SEB's The Green Bond report: Raised forecasts for transition investment. Page 11.
7. United Nations Press Release. Secretary-General Urges Protecting, Restoring Degraded Land in Message for World Day to Combat Desertification. SG/SM/19621-ENV/DEV/1960-OBV/1889 12 June 2019.
8. Hodapp D, Roca I, et al. Climate change disrupts core habitats of marine species. Global Change Biology, Volume 29, Issue 12, June 2023, pages 3304-3317. DOI:10.1111/gcb.16612
9. Lindwall C. Climate tipping points are closer than once thought. NRDC; 2022.
10. Hunziker R. Climate change trial at the Hague. pressenza. December 19, 2024.
11. Hutchinson RW, Smith Jr. D. People's Assessment of Global Warming, Plus Adaptations for Advancement and Survival. Self-published with Amazon; 2019.
12. GSOP Problem Diagram (detailed GSOP proposal). Available online: https://www.climate-collaboration.com/gsop-problem-diagram (accessed on 2 February 2025).
13. Villareal A. Meet the doomers: why some young US voters have given up hope on climate. The Guardian. September 21, 2020
14. Haine A. McKinsey: Net-zero transition will cost $275 trillion globally by 2050. The National; 2022.
15. To donate to GSOP Climate Collaboration, Inc. Available online: https://tinyurl.com/GSOPdonatewithPayPal (accessed on 2 February 2025).
16. Perez A. World Reporter, GSOP Climate Collaboration Inc. Pioneering Global Change. February 16, 2024