TERRA PRAXIS

CLIMATE SOLUTION PROFILE / REPOWERING THE GLOBAL COAL FLEET BY 2050

MAY 2023

ACTING LIKE IT IS A CLIMATE EMERGENCY

Widespread impacts from climate change are already here. Our actions in this decade are critical. There is a widening gap between decarbonization policy targets and the real world of clean energy deployment. It is highly probable that the world will fail to achieve Net Zero emissions by 2050 and experience catastrophic climate change in this century unless new solutions are pursued at speed and scale.

Repowering existing coal plant infrastructure is the largest single carbon abatement opportunity on the planet and could greatly accelerate the clean energy transition.

THE PROBLEM: Today, 2 terawatts (TWe) of coal-fired power plants are responsible for more than one-third of global net annual CO_2 emissions. Despite international agreements reached at COP26 in Glasgow in 2021 to "phase out" coal use, CO_2 from coal combustion hit a record high in 2022. Coal power generation is a key driver of economic growth in developing and developed countries so simply shutting it down is economically and politically unrealistic. Interest in repowering these coal plants with emissions-free heat sources (advanced fission, fusion, and geothermal) is gathering steam but requires a new delivery model to achieve the scale and rate of deployment necessary to convert the entire global fleet by 2050.

OUR SOLUTION: Terra Praxis is designing a system that will enable the rapid repurposing of coal plant fleets with non-emitting advanced heat sources. This will allow for the continued operation of a sizable portion of existing power plants—without emissions. Repowering coal plants leverages existing sites, infrastructure, transmission lines, industry knowledge, workforces, capital, and supply chains to accelerate the clean energy transition. It also ensures continuity for communities reliant on existing power plants for energy, jobs, tax revenue, and continued economic development.

Terra Praxis is a nonprofit organization that exists to de-risk the energy transition. Powered by philanthropy, Terra Praxis is innovating transformative climate change solutions for the difficult-to-decarbonize sectors of coal-for-power, industrial heat, and heavy transport. Terra Praxis shines a light on risks to the global energy transition that threaten the deployment of clean energy at speed and scale. With this clear-eyed perspective, Terra Praxis designs and innovates scalable solutions in response to these challenges. We lead deep engagement with industry, governments, regulators, academic institutions, energy systems modelers, and other non-governmental organizations to diversify and expand the range of tools available for deep decarbonization.

Read our latest Annual Review.

COAL POWER: ONE-THIRD OF GLOBAL EMISSIONS

As of 2022, the world has more than 2 TWe of coal-fired electric power plants, adding roughly 12 gigatonnes of CO_2 emissions per year (Figure 1).[1] These annual emissions amount to almost one-third of global total forecast net annual emissions of 38.8 gigatonnes/year.[2] In 2022, global consumption of coal reached record highs. European countries reactivated coal plants due to the worldwide energy crisis, reversing years of climate legislation intended to shut them down. Asian and African countries continue to build new coal plants to meet growing demand from increasing populations, rising standards of living, and industrialization.

Some policy makers, climate modelers, and activists incorrectly assume that countries will simply shut down their coal plants to reduce carbon emissions. But, because more than half of coal plants worldwide are less than 14 years old, it is unrealistic to expect such young assets to simply retire, especially considering growing energy demand and supply shortages.

Even where there are relatively old coal plants, such as in the U.S., Canada, and Europe, closing coal plants is difficult and controversial because the loss of jobs and revenues can be devastating for communities, and utilities continue to value the reliable electricity generated. These challenges create strong political and cultural opposition to the conventional climate agenda, especially in developing countries.

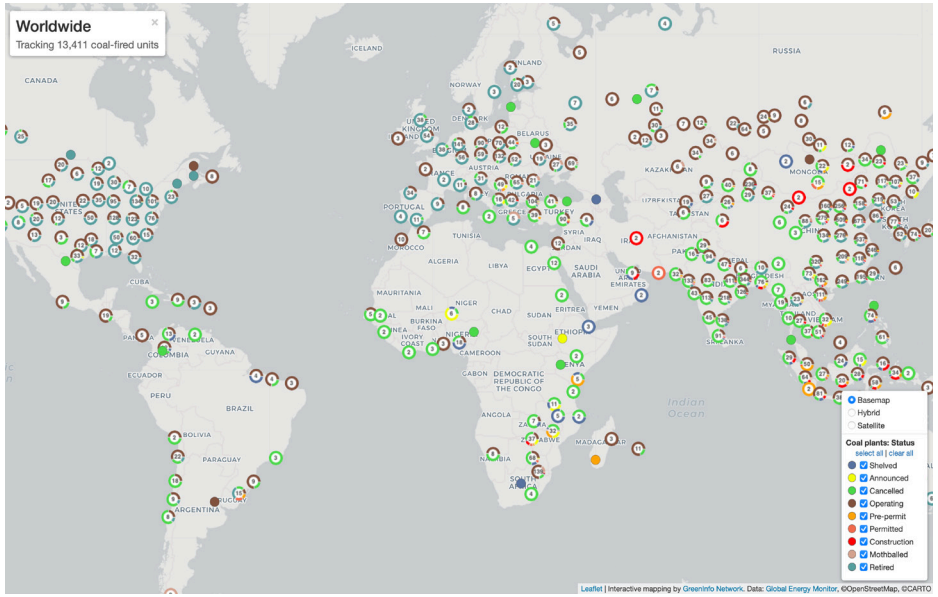
REPOWERING COAL: A NEW PATH

In Wyoming, the largest producer of coal in the U.S., Bill Gates's advanced reactor company, TerraPower, announced plans to build its Natrium reactor near the retiring Naughton coal plant in Kemmerer. The U.S. Department of Energy plans to invest nearly $2 billion to support the licensing, construction, and demonstration of this first-of-a-kind reactor by 2028.

By locating the Natrium reactor near the retiring Naughton coal plant, TerraPower can not only take advantage of the existing energy infrastructure that is in place (such as cooling water and transmission), but also the workforce.

While this project in Wyoming is a welcome step and an important signal of the demand for such solutions, we need a strategy that will enable the rapid repowering of all coal plants. To work, that strategy must be fast, cheap, minimize construction risk and enable the participation of a much broader range of suppliers and constructors.

Figure 1. **Global coal plant tracker map**



Achieving Net Zero carbon emissions over the next 27 years will require a massive, simultaneous, and international infrastructure buildout. It is an unprecedented logistical challenge because it needs to happen so quickly. Repowering coal plants can reduce the complexity of this challenge.

THE OPPORTUNITY: CONVERTING COAL POWER PLANT FLEETS TO EMISSIONS-FREE GENERATORS

Repowering existing coal plant infrastructure is the largest single carbon abatement opportunity on the planet. By replacing coal-fired boilers at existing coal plants with carbon-free small modular reactors (SMRs), also known as *advanced heat sources*, these power plants can generate carbon-free electricity, rather than carbon-intensive electricity. This would quickly transform coal-fired power plants from polluting liabilities facing an uncertain future, into jewels of the new clean energy system transition—an important part of the massive and pressing infrastructure buildout needed to address climate change. This would also enable a just transition by sustaining the jobs and community tax revenues associated with existing coal plants; the larger social, economic and

environmental benefits associated with continued reliable and flexible electricity generation; and the continued use of existing transmission lines—without emissions.

Repowering coal fleets therefore offers a fast, large-scale, low-risk, and equitable contribution to decarbonizing the world's power generation.

Converting 5,000 – 7,000 coal plant units globally between 2025 and 2050 (250 – 350 per year) will require a redesigned delivery model to achieve this rate of deployment. To be successful, the deployment model has to de-risk the construction process: the riskiest part of a project. To successfully de-risk, we must provide coal plant owners and investors with high-certainty schedules and budgets. To this end, purpose-built automated tools can achieve rapid, repeatable, and confident project assessments. By establishing planning confidence, modern automated tools can facilitate initiation and completion of repowering projects.

THE GLOBAL REPOWER CONSORTIUM

To achieve this vision, Terra Praxis has assembled a world-class consortium of partners, governments, regulators, academics, and industry stakeholders—to design a fast, low-cost, and repeatable project delivery model for repowering 2,400 coal plants worldwide.

The global REPOWER consortium has already attracted some of the world's largest and most innovative global leaders in the critical disciplines required for success, including Bryden Wood, Microsoft, University at Buffalo, Massachusetts Institute of Technology (MIT), Schneider Electric, AVEVA, X-Energy, Copenhagen Atomics, Terrestrial Energy, Seaborg, and others (Figure 2).

Repowering Coal will deliver a substantial portion of the clean electricity required to achieve Net Zero by 2050 by replacing coal-fired boilers at existing power plants with advanced heat sources, which are expected to be ready for deployment by 2028. While the companies commercializing the advanced heat sources ready their products for market, the Terra Praxis REPOWER consortium will develop standardized, pre-licensed designs supported by automated project development and design tools to enable hundreds of customers to be ready to start construction on their projects in the late 2020s.

The result of this repowering will be carbon-free power plants that are cheaper to operate than before, and to ensure continuity for communities reliant on these plants for energy, jobs, and continued economic development.

Figure 2. **The global REPOWER consortium includes innovation leaders**

> "As part of this pivotal moment to reach Net Zero, we are proud to partner with Terra Praxis to help transition one of the world's largest sources of carbon (coal) to zero emissions."
>
> Gary Lawrence, Schneider Electric, Power & Grid Segment President

DESIGN INNOVATIONS TO ENABLE STANDARDIZATION

The Terra Praxis REPOWER system is designed to be broadly applicable, because coal-fired power stations come in a wide variety of sizes and configurations. Further, there are multiple potential vendors of advanced heat sources, resulting in a wide variety of requirements for repowering (Figure 3):

- Different inlet mass flow, pressure, and temperature requirements for the existing steam turbines.
- Different advanced heat source technologies as potential repowering options and their associated systems.
- Different site layouts and local requirements.

The combination of these factors would typically result in the requirement for a bespoke design for each new project, with the costs, regulatory review uncertainties, and risks to budget and schedule that will prevent most projects from moving forward.

The REPOWER system embraces key design innovations to enable standardization while accommodating coal fleet diversity. These include 'kit-of-parts'-based design, standardization of supporting systems across multiple heat source vendors, a 'universal connector' heat transfer and storage system, and seismic isolation (Figure 4).

'Kit-of-parts'-based design

The 'kit-of-parts'-based design enables the plant to be reconfigured and expanded to accommodate different numbers of advanced heat sources while staying within its pre-approved regulatory envelope (Figure 6).

Standardization of supporting systems

Standardization also addresses the differing requirements of a range of advanced heat sources (Figure 12), so they can be housed in the standardized building, and connected to steam generators using a standardized heat transfer system. The building-integrated reactor system can be configured to meet requirements for a variety of site layouts, energy and heat demands (Figure 13).

Heat transfer and storage system

In addition to building standardization, standardization is further leveraged by sharing the system architecture choice of delivering heat from the advanced heat source to the steam boiler using molten salt as the heat transfer fluid. These standardized design elements provide an adaptation-point, where standard components can be connected to existing plants.

Figure 14 shows storage tanks which are part of a standardized heat transfer and storage system. This system allows the new modular reactor systems to 'plug in' to existing coal plant infrastructure. This standardization and reduction in design work enables a higher volume manufacturing model for all aspects of the plant, and delivers radical cost reduction. Reusing the power island and other infrastructure from the existing plant avoids those costs. Figure 21 shows a site-level view of a repowered plant, and shows an example placement of the heat storage tanks and reactor buildings.

Figure 3. **The challenge to standardization**

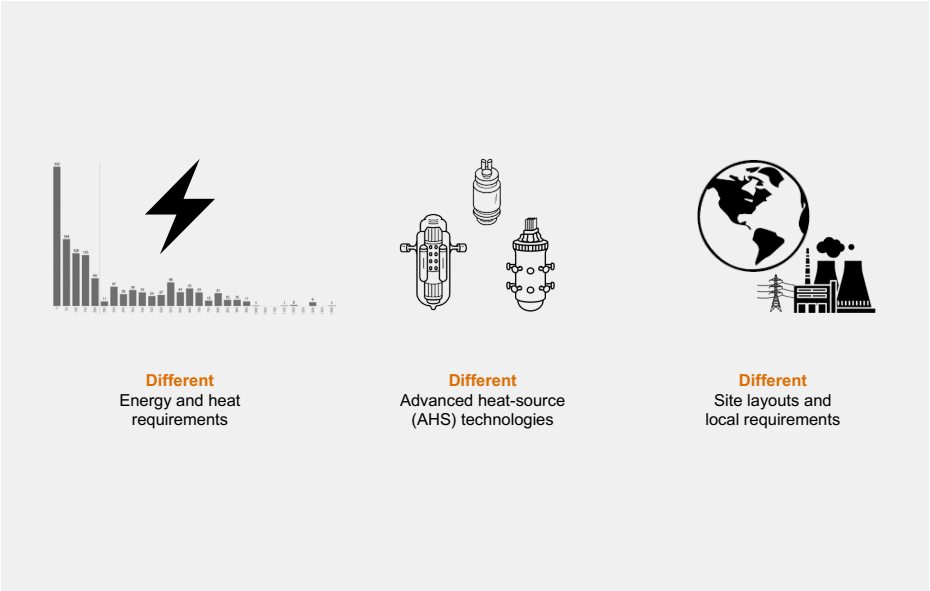
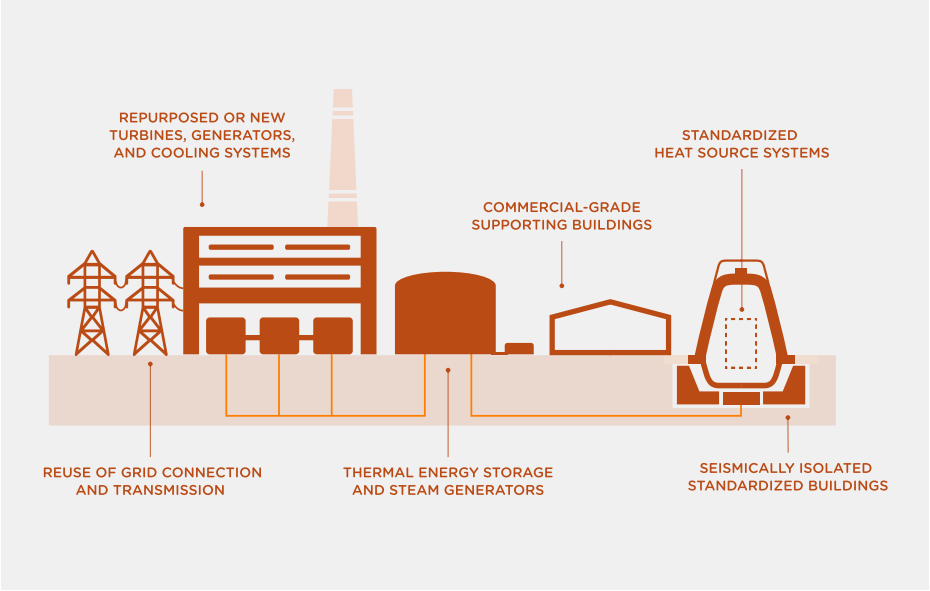


Figure 4. **Design innovations to enable standardization**



Seismic isolation

Seismic variation usually drives the site-specific design of nuclear plants, representing a major cost driver and making standardization impossible.[3] Redesign increases design engineering costs and requires new regulatory approval each time, increasing cost and schedule uncertainty.

These dynamics are studied by Professor Andrew Whittaker at the University at Buffalo, a global expert on nuclear plant seismic isolation. His research finds that separating the reactor building from the building's foundation via seismic isolation can allow for a reusable building design.[4] This allows the same building to be reused at multiple sites of varying seismic risk. Site-to-site seismic variation can then be addressed by these seismic isolation components. Professor Whittaker is leading the seismic isolation system design with the goal of facilitating standardization. Whittaker's work will enable the plant to be designed for a range of seismic conditions and licensed once, allowing a rapid roll-out across a wide range of sites (Figure 5).

Figure 5. **Seismic isolation to enable standardization**

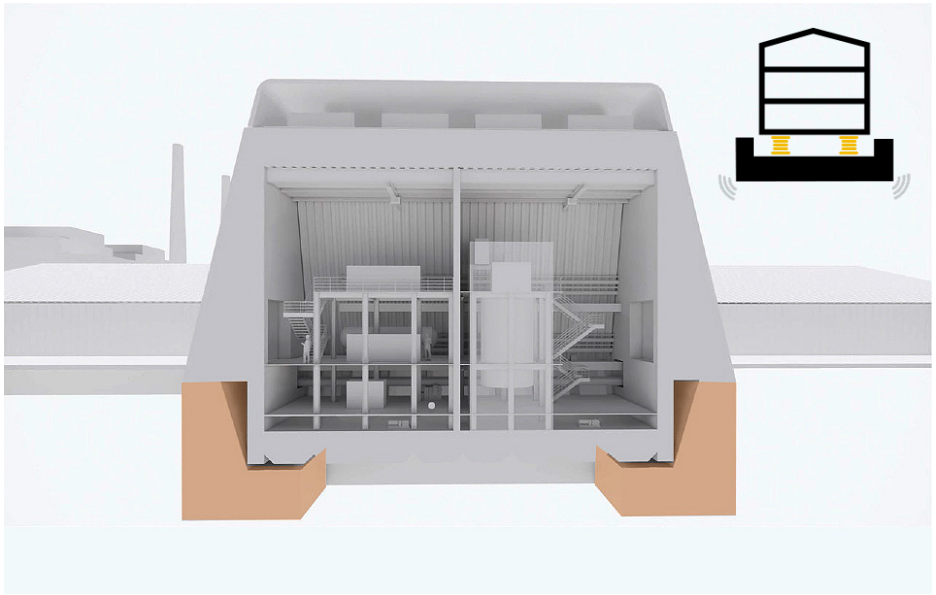
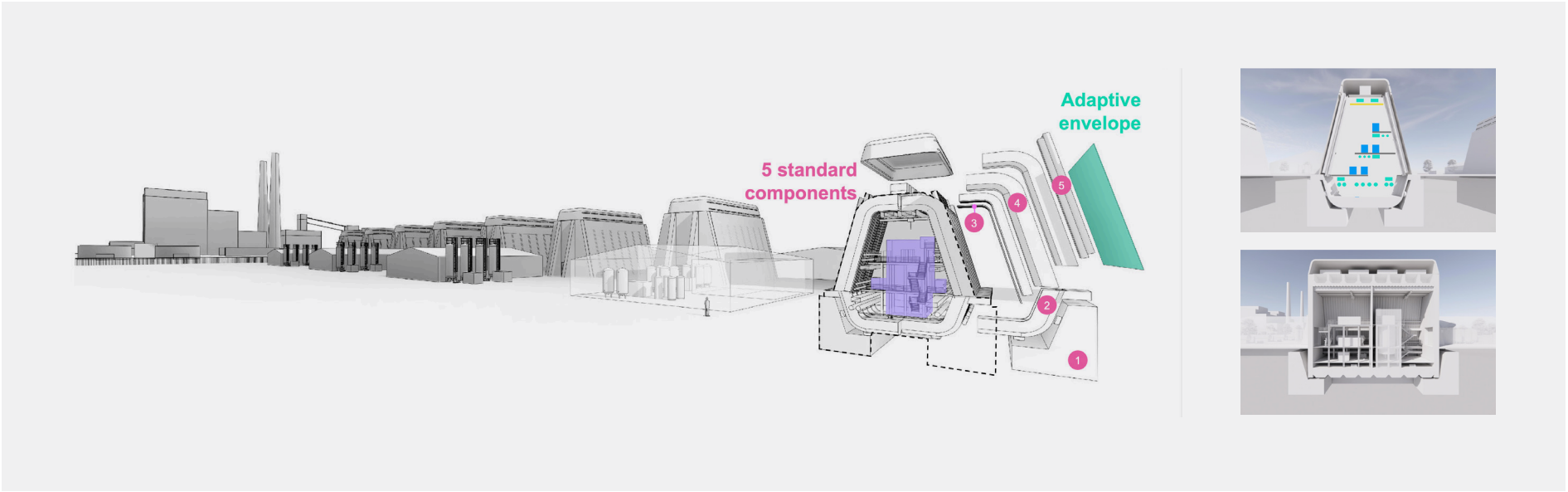


Figure 6. **Building system can be reconfigured and expanded to accommodate different types and numbers of advanced heat sources**



STANDARDIZATION MEANS REDUCED COST, TIME, & RISK

Target cost is $2,000/kW

The REPOWER system cost target is $2,000/kWe. This can be achieved through key design and delivery innovations shown in Figure 7. This includes: reuse of the existing power island; a standardized completed design, which eliminates hundreds of millions of dollars of design engineering each time; standardized licensing applications; a 'kit-of-parts' approach which radically lowers construction complexity, duration, and supervision requirements; and a manufacturing-based supply chain, enabling highly productive use of labor and multiple suppliers for all components.

Target schedule is 5 years

By starting with a completed and licensed standardized design, a REPOWER project can be rapidly (as shown in Figure 8) adapted to meet plant and site requirements. REPOWER customers will have access to automated design tools to eliminate years of design engineering work in a typical project. Site licensing and permitting is reduced by template-based standardized applications. Construction schedule is greatly reduced and simplified by the 'kit-of-parts' approach, which is designed for high quality manufacture and rapid assembly onsite. Mechanical and electrical systems will arrive at the site in relatively complete modules and pre-commissioned. These best practices—proven and demonstrated in other complex and high performance industries—will eliminate more than 7 years from a conventional power plant project schedule.

Target risk: standard commercial risk

All projects have risks, but attractive projects have low, well-defined risks, (Figure 9) with well-understood and effective ways of managing the remaining risk. The global REPOWER consortium is focused on eliminating and reducing risks *by design*, and using best practices from other industries.

> "With these technologies now maturing, the next horizon is about their deployment, which is really a bridge to bankability for nuclear. And that is to me, what we are really talking about here today — that we need a phased approach to the deployment of new nuclear that prioritizes speed to market."
>
> Jigar Shah, Director of the Loan Programs Office at U.S. Department of Energy

Figure 7. **Target cost**

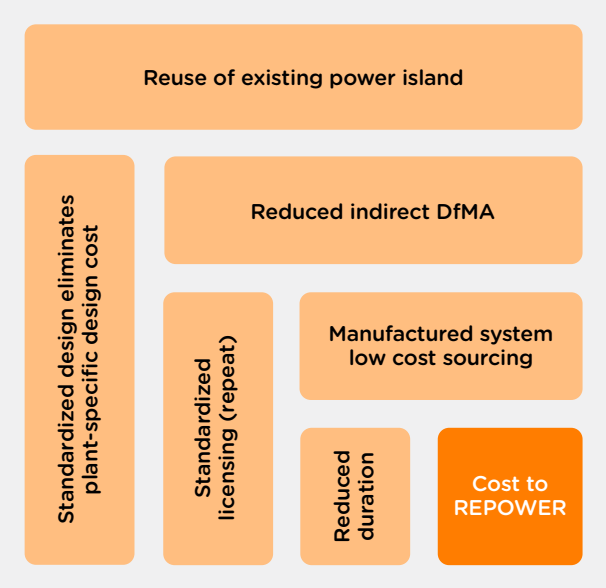


Figure 8. **Target schedule**

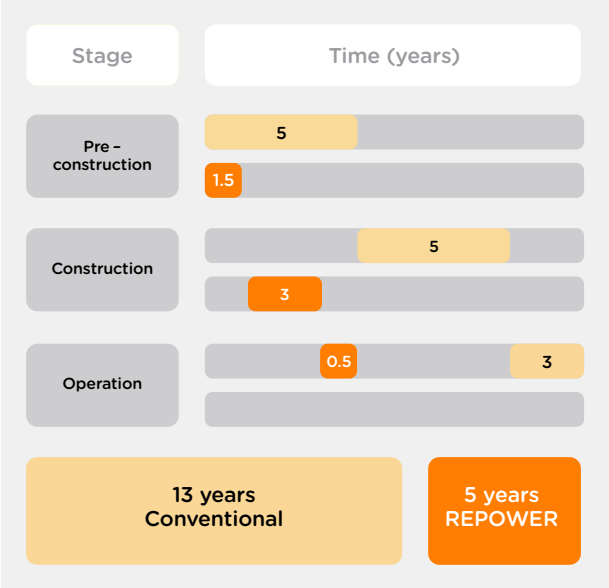
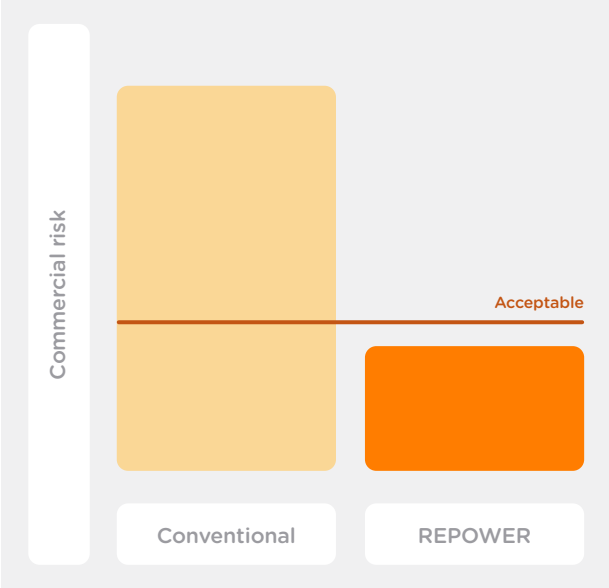


Figure 9. **Target risk**



A NEW DIGITAL PLATFORM

In addition to innovative building system design strategies, the global REPOWER consortium is creating new purpose driven digital tools and data exchange infrastructure for the building system.

Together with Microsoft Vice Chair & President Brad Smith, Kirsty Gogan and Eric Ingersoll of Terra Praxis (Figure 11) launched the first version of an open-access repowering coal application at COP27. The EVALUATE application enables governments, coal plant owners, investors, and project developers to quickly evaluate the site-specific business case for repowering a plant or fleet of plants. Drawing on public sources, Terra Praxis aggregated a global data set that allows individuals to explore information about coal plants across the globe. Current features include estimated project costs and savings, reduced carbon emissions, and the potential for adding skilled jobs. Planned upgrades include a bottom-up cost model, preliminary conceptual design information, multiple reactor types, and site-specific hazard analysis. Learn more about the EVALUATE application.

Future digital applications will focus on standardizing and optimizing the following:

- Procurement, investment, and regulatory approval.
- Building and engineering systems.
- Design, manufacture, assembly, and operation.
- Interactions between supply chain organizations increasing collaboration.

Microsoft and Terra Praxis have been working together creating Azure tools to enable automated analysis of the U.S. (and ultimately global) coal fleet for retrofit. Microsoft will build the analytics tools with Terra Praxis, and help undertake strategic partnerships with REPOWER consortium stakeholders.[5]

> "Terra Praxis is at the absolute center of the world's innovation to cut the cord between power and carbon, while enabling the world to continue to rely on the power plants that have been built and the infrastructure that already exists."
>
> Brad Smith, Microsoft Vice Chair & President

The goal of the analytics tools is to quickly assess repowering design options for a large number of coal power plants. For each of many plants, the tools integrate: plant thermal assessment, steam unit configuration, site assessment, and heat source options; while reusing the existing balance of plant, such as turbines, switchyards, transmission infrastructure, buildings and roads.

A further goal is for the tools to capture and communicate developing design knowledge, allowing all parties to share results and status in real time across projects.

Figure 10. **Terra Praxis EVALUATE application, global coal plant data overview**

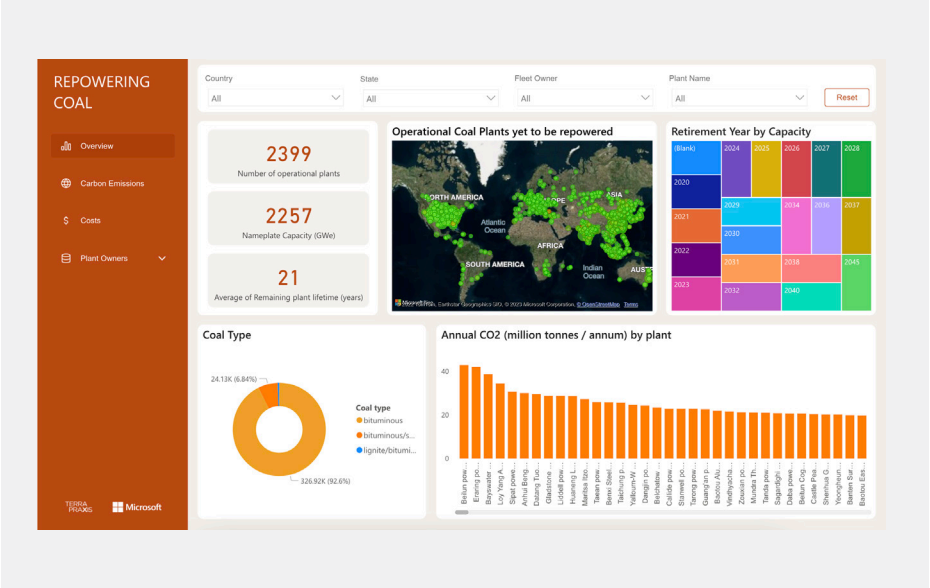


Figure 11. **Microsoft-Terra Praxis strategic collaboration agreement signing**

Figure 12. **Standardization for a range of advanced heat sources requirements**

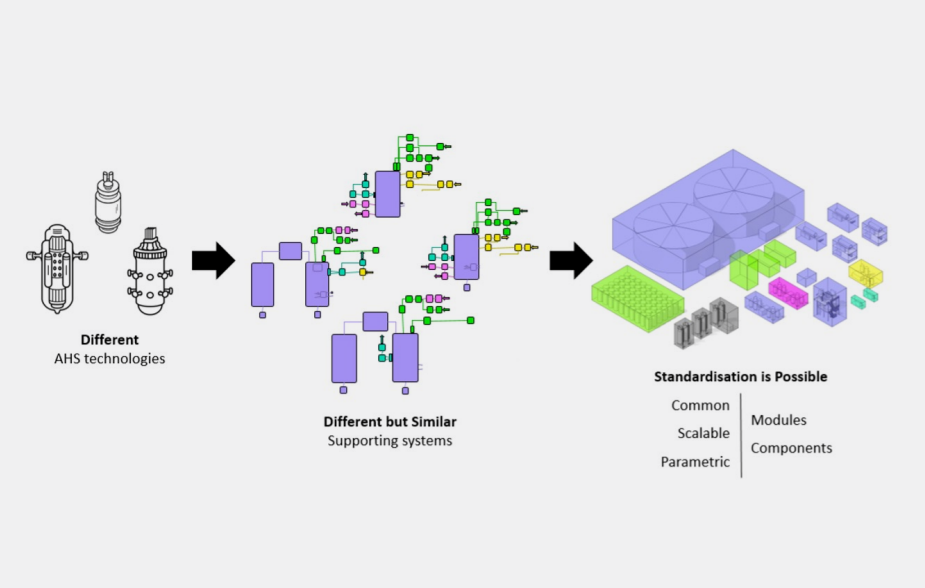
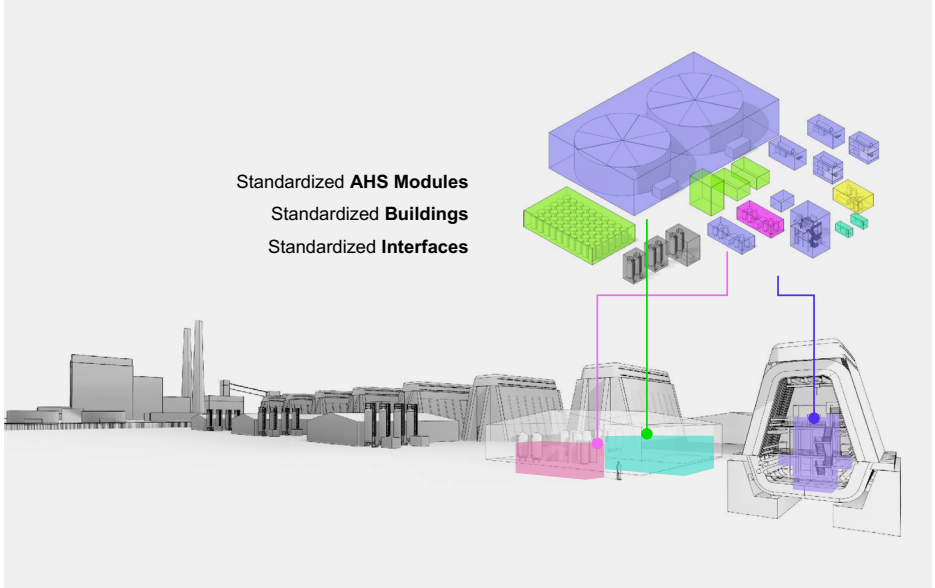


Figure 13. **Standardized building system**



Algorithmic design tools are being created by Bryden Wood to:

- Assess coal plant viability for boiler replacement.
- Create initial concepts using a design configurator in just days.
- Produce detailed design outputs for manufacturing.

The design process incorporates an ongoing process for establishing and enhancing a catalog of vetted, mass-produced standard components. Components may be proposed by existing or new manufacturers. Where appropriate, plant elements may be assembled on-site by non-nuclear specialists.

Together, the tools will create a completely open digital platform to which all stakeholders may be granted access and will be able to contribute. For the first time in the nuclear energy sector, there will be a seat at the design table for everyone; from plant owners to regulators, suppliers, advanced heat source vendors, customers, communities, investors and assemblers. Role-based access control will allow for sophisticated configuration and control of data security. Now, for the first time, it will be possible to connect everyone involved in a project through a digital platform and give them access to all the information about their project and create a mechanism for capturing their input at every step of the design and development process.

Figure 14. **Customizable heat transfer and storage system**

Similar automated site assessment and design tools have been designed and tested by Bryden Wood in other highly complex, highly regulated sectors, such as pharmaceuticals, highways and data centers (Figure 16). These will be greatly enabled by software engineering and tools development, as well as by the financial model that will enable coal plant owners to evaluate the benefits and value creation opportunities from repowering.

This means that instead of having to spend hundreds of millions of dollars—and potentially years—evaluating the prospects for a single site (making it unlikely to happen at all), the evaluation of a site for repowering will be extremely fast, low-cost, and repeatable.

The end-product will enable coal plant owners to begin pre-development analysis for their fleets using these tools to evaluate the financial, social and environmental benefits of repowering with a high level of certainty with respect to requirements for budgeting, scheduling, licensing and site development. This, in turn, could make existing coal plants into attractive assets, making it easier for owners and investors to build, maintain and operate them as new clean energy plants across a broad range of markets.

The pathway to repowering

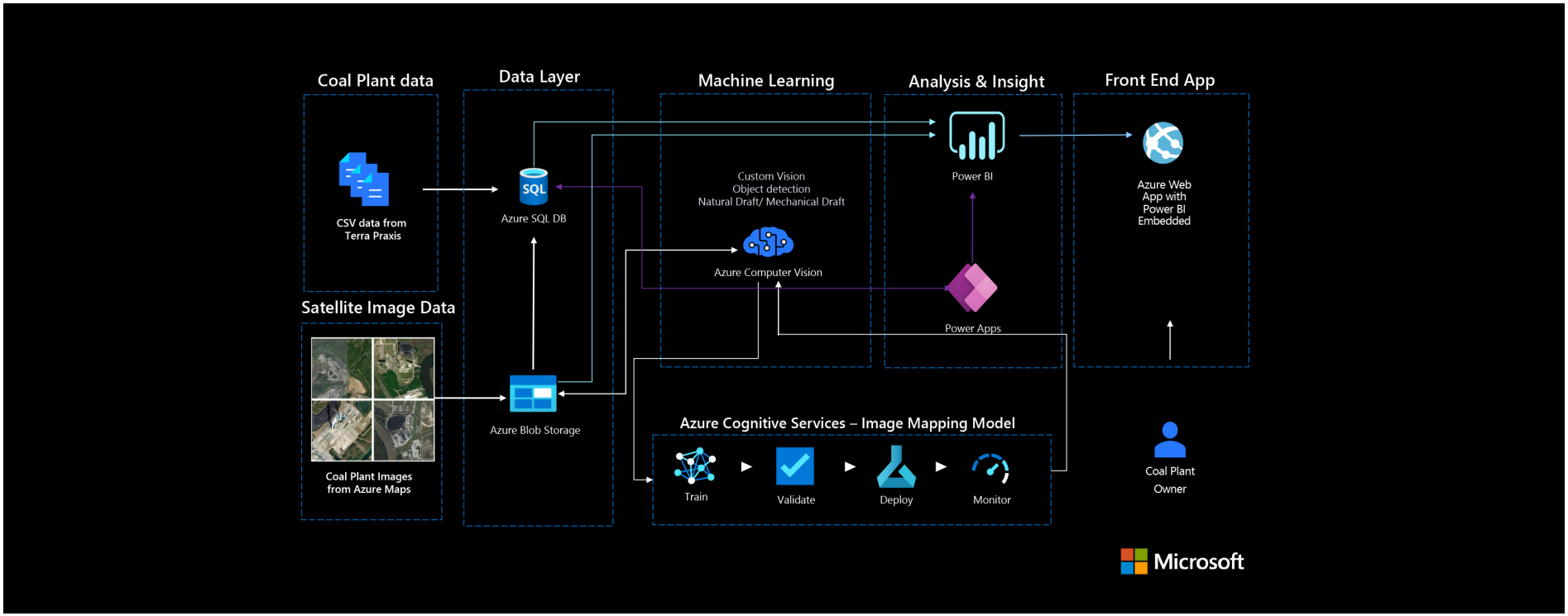
To be successful, we must address barriers to fast, low-cost and scalable repowering, such as untenable pre-development, project delivery, licensing and supply chain costs and risks. All the key stakeholders associated with a repowering project (Figure 18) ought to be at the design table to enable new interactions that leverage the value of the digital tools and the repeatability of the design, in order to overcome these challenges.

Figure 19 shows the range of tools being developed to radically improve the costs, risk profile and timescales for each stakeholder type that will transform project design, licensing, development, and delivery.

As discussed, the tools will leverage research from consortium members on seismic isolation systems, as well as automated design and project development tools that have been built and demonstrated in other complex, highly regulated industries.

Figure 20 shows how the tools will support customers throughout the project development and delivery process, starting with automated site assessment and design tools, followed by project definition using the automated configurator.

Figure 15. **Repowering Coal architecture and tools implemented by Microsoft Azure**



Site-specific design is also greatly accelerated by the ‘kit-of-parts’ components designed for manufacture and assembly, which include standardized information for suppliers, constructors and operators. Regulators can interact with the platform to receive licensing information provided through existing templates and online tools for verification and certifications.

As discussed, standardization is enabled by design innovations, including seismic isolation and heat transfer and storage systems, standardized components, and automated design tools. This will enable accelerated licensing for large markets and low-cost, low-risk investment decisions by investors, coal plant owners, and supply chain. The ability to choose the heat source later in its commercialization process mitigates technology risk.

As advanced heat sources reach the market, these tools will enable large-scale market development (Figure 17). This maximizes climate benefit by insuring the broadest possible deployment of the heat sources that successfully complete the commercialization process.

The users of the platform are current and prospective coal plant owners, project developers, policymakers, and regulators. Our customer advisory group includes some of the largest utilities in the world. Terra Praxis expects the customer group to be reviewing hundreds of sites globally by the end of 2024.

Product development timeline

The tools will ultimately integrate full preliminary designs, cost estimations and detailed construction schedules, and reflect preliminary inputs from regulators. The team plans to complete the financial site assessment and automated design tool by 2024, which will coincide with the development and testing of a digital licensing process using dozens of real sites and simulated projects. These tools are specifically designed to inform investment decisions (Figure 20).

Starting in 2025, the team will further develop the tool in order to fully automate detailed plant design, integrate project management functionality, and establish supply chain integration interfaces. At that point, the platform will reflect thousands of hours of direct engagement with regulators to develop ‘pre-approved’ design work and a mechanism for digital licensing.

Figure 16. **Automated assessment and design tool**

REGULATORY ENGAGEMENT

> "First, I would like to applaud Kirsty Gogan and Eric Ingersoll on their work around flexible nuclear applications, including heating, hydrogen, and repowering coal plants, with small modular reactors. This kind of ingenuity serves as a reminder: regulators must always be ready for whatever comes our way... we need to know and understand what's coming."
>
> Rumina Velshi, President & CEO of the Canadian Nuclear Safety Commission

The building system is designed to reduce regulatory scope by firstly separating the power island from the heat island via thermal energy storage. This delinks the heat island regulatory safety case from the power island, enabling the continued use of the coal plant balance of plant.

Secondly, advanced heat sources have adopted passive safety systems,which reduces complexity and site infrastructure requirements. The relatively small reactor building, assembled from pre-fabricated components, therefore becomes the only safety-related building. As part of their license review for a project, the regulators will have already reviewed this exact configuration and its associated building designs.

Figure 17. **Priming the market for mass deployment**

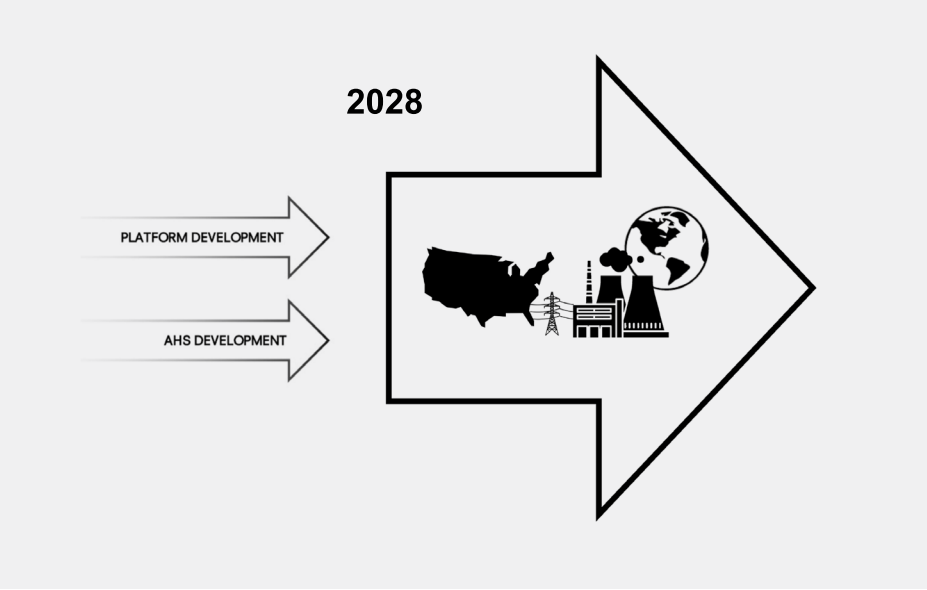


Figure 18. **Key stakeholders interacting throughout the repowering process**

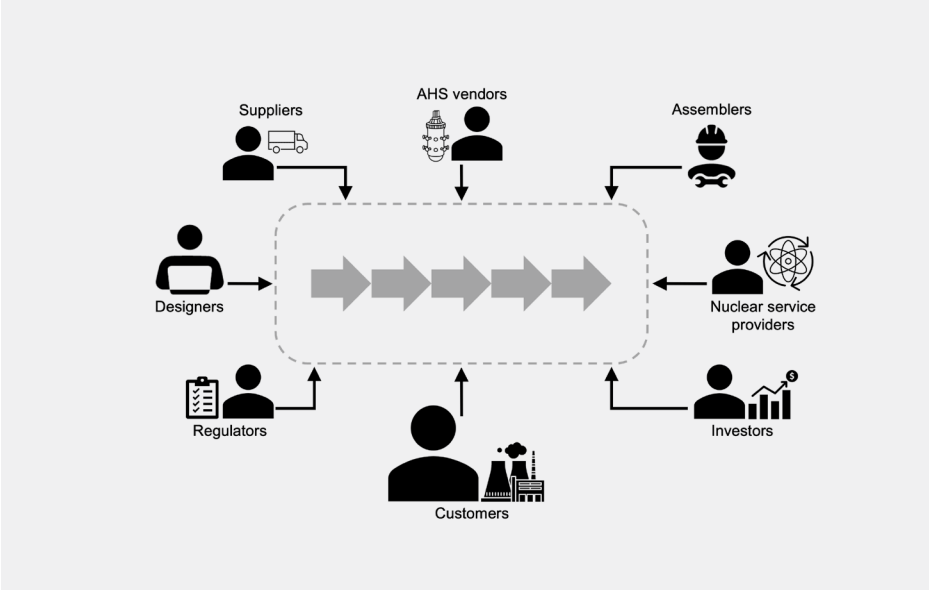
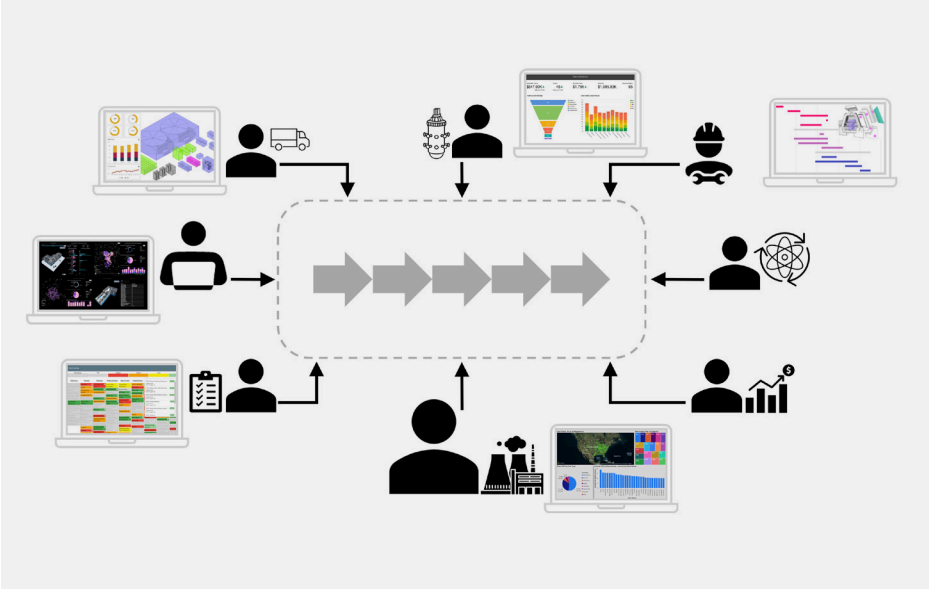


Figure 19. **Range of cloud-based tools designed for each stakeholder**



Earning regulatory approval for the standard design elements and achieving rapid, reliably repeatable design automation is fundamental to REPOWER.

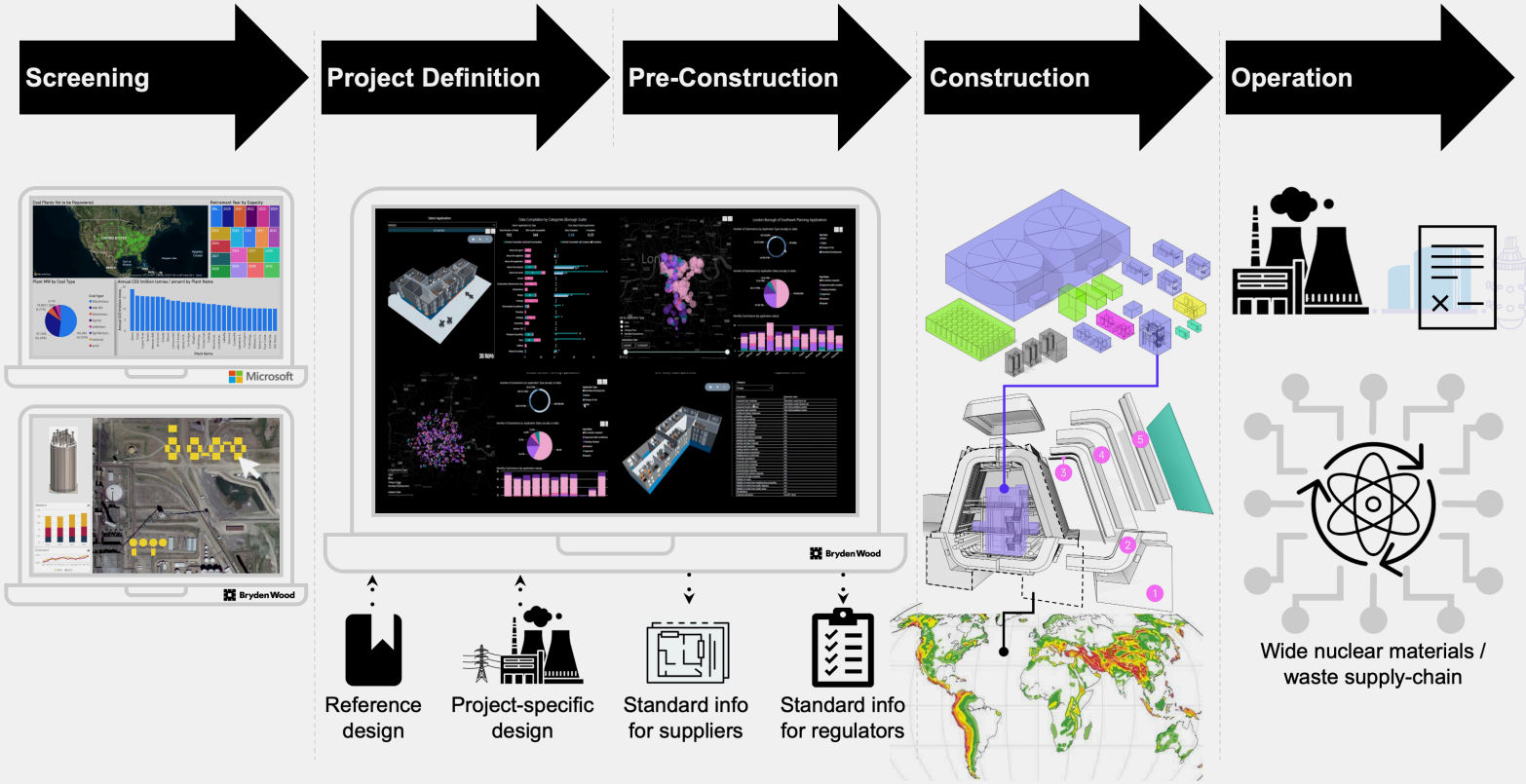
The tools will enable a paradigm shift and transformative reduction in cost and time required for regulatory engagement, documentation, approvals, and oversight.

The team works closely with regulators to define, and design for, requirements for product-based licensing; leveraging regulators' feedback.

INTELLECTUAL PROPERTY

Microsoft will assist Terra Praxis in developing the hosted cloud services infrastructure and this will be hosted by Terra Praxis on Microsoft Azure (Figure 15). The tools are designed to expand and support multiway data exchange among all supply chain participants. Data exchange will enable electronic modes of construction management and project delivery.

Figure 20. **Tools support stakeholder interactions through project delivery**



CONCLUSION

In summary, this paper describes a fast, low-cost, and repeatable strategy to repower hundreds of existing coal plants that would otherwise continue to burn coal, or whose closure would cause economic harm to communities.

- Our partners at Bryden Wood are designing a standardized building system, designed for manufacture and assembly, incorporating seismic isolation to eliminate the need for site redesign.
- The building system will be configurable to accommodate a range of advanced heat sources, sites, and power plant requirements.
- The heat transfer and storage system being designed by MIT acts as a versatile USB-style 'plug and play' system for a range of existing power plants.
- The digital infrastructure being built with Microsoft and hosted on Microsoft Azure will enable all key stakeholders, including regulators, suppliers, and customers, to have a seat at the design table for the first time in the nuclear energy sector.

Repurposing the majority of existing coal plant sites and infrastructure, including transmission, and maintaining the workforce employed today, dramatically reduces the investments and effort otherwise required to site, plan, build, and connect new infrastructure. (Figure 21 shows a rendering of a repowered 1,200 MWe plant.)

By sustaining permanent high-quality jobs for communities, repowered coal plants reduce the negative impacts on communities to help enable public and political support for a just transition. The challenge is not only to build enough clean electricity generation to power the world, but to do so quickly. Repowering is a way to accelerate and de-risk global decarbonization.

Figure 21. **Rendering of a repowered 1,200 MWe, two-steam-unit plant**

LEARN MORE

Terra Praxis' REPOWER solution has enabled a paradigm shift in how many major entities—including governments, the International Energy Agency, the U.S. Department of Energy, regulators, the International Atomic Energy Agency, major companies, power plants, utilities, and heat source vendors—think about how to tackle coal and climate change. Terra Praxis' solution was featured by the U.S. Department of Energy and the International Energy Agency in their landmark publications in 2022. Together with our partners—leaders in finance, government, and nonprofits—we are transforming the global narrative from "phasing out" coal-fired power plants—as agreed upon at COP26—to repowering coal plants with emissions-free heat sources to accelerate a clean and equitable energy transition.

Key publications

Can Advanced Nuclear Repower Coal Country?, John Jacobs and Lesley Jantarasami, Bipartisan Policy Council, March 2023

As SMRs shift toward commercial deployment, identifying the existing opportunities and hurdles is vital to create a pathway for future coal-to-nuclear transition projects. This report analyzes the benefits and challenges of a coal-to-nuclear transition and highlights recent legislation that may hasten such a transition.

How Small Modular Nuclear Reactors Can Help Decarbonize Power Grids: Nuclear's New Role, KPMG International, 2023

KPMG reports on Terra Praxis' initiative repowering 5,000 to 7,000 coal plants globally with SMRs between 2030 and 2050. Whether replacing coal in power plants or supplying industrial processes, SMR reactors have the potential to be installed in a packaged fashion based on standardized designs and processes. This should mean they can be deployed more quickly and with greater certainty over the likes of outcomes, costs and regulatory approvals than nuclear power has to date.

Investigating Benefits and Challenges of Converting Retiring Coal Plants into Nuclear Plants: Nuclear Fuel Cycle Supply Chain. Prepared for U.S. Department of Energy Systems Analysis and Integration, September 2022

This report corroborates the technical and cost benefits of repowering coal plants outlined by Terra Praxis, including decreased capital costs, reduced energy costs, and increased economic activity. The report concludes that 80% of retired and operating coal power plant sites that were evaluated within a sample of 394 have the basic characteristics needed to be considered amenable to host an advanced nuclear reactor. The study team found regional economic activity could increase by as much as $275 million and add 650 new, permanent jobs to the sample coal plant community region of analysis.

> "Various initiatives can facilitate the replacement of coal-fired plants with SMRs (small modular reactors), such as that of Terra Praxis which aims to prepare standardized and pre-licensed designs supported by automated project development and design tools."
>
> IEA report, Nuclear Power & Secure Energy Transitions (2022)

Nuclear Power and Secure Energy Transitions: From Today's Challenges to Tomorrow's Clean Energy Systems, International Energy Agency (IEA), 2022

This IEA report concludes that achieving Net Zero globally will be more difficult without nuclear and highlights Terra Praxis's initiative as a vehicle to achieve decarbonization by repowering retired coal plants globally with clean energy.

Repowering a Coal Power Unit with Small Modular Reactors and Thermal Energy Storage, Energies, Łukasz Bartela, Paweł Gładysz, Jakub Ochmann, Staffan Qvist and Lou Martinez Sancho, 2022

Repowering coal plant infrastructure with clean heat sources such as nuclear and geothermal energy is crucial if we want to reach the Paris Goals of Net Zero by 2050. This article, written by our colleagues from QuantifiedCarbon (QCL) proposes and analyzes a solution that will enable the flexibility of electricity production of new nuclear energy while avoiding the stranding of existing fossil fuel assets and local job losses.

Small Modular Reactor: A New Nuclear Energy Paradigm, International Atomic Energy Agency, September 2022

Read this if you want to get a quick and realistic understanding of how SMRs could be a game-changer. This new report from the International Atomic Energy Agency (IAEA), available as a pre-print, is the Secretariat's view on SMRs. It talks about three major areas: (1) understanding SMRs, (2) what will it take to make SMRs a success, and (3) what's next for SMRs. The last chapter provides a comprehensive list of IAEA activities to support SMR deployment.

The Nuclear Energy Agency (NEA) Small Modular Reactor Dashboard, OECD-NEA, 2023

With a shift from conventional large-scale construction to factory manufacturing to drive down costs and leaps in technology that will allow flexible and diverse applications, a portfolio of SMR products is racing to the market. The NEA SMR Dashboard includes analysis of 21 SMR designs and the progress towards their deployment and commercialization.

JOIN US

Time is short. Join us in accelerating the single largest carbon reduction opportunity on the planet. Repowering coal plants could eliminate almost one-third of global carbon emissions, or around 15 billion tonnes of CO_2. to help the world achieve Net Zero. We invite all parties with an interest in pragmatic and global-scale solutions for tackling the climate crisis to join us.

You can find out more at terrapraxis.org

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ENDNOTES

1 Global Coal Plant Tracker, Global Energy Monitor, February 2022.

2 Terra Praxis 2022 analysis of IPCC 2021 AR6 data.

3 MIT Future of Nuclear, 2018.

4 Parsi, Sai Sharath; Lal, Kaivalya; Kosbab, Benjamin; Ingersoll, Eric; Shirvan, Koroush & Whittaker, Andrew. Seismic isolation: A pathway to standardized advanced nuclear reactors. *Nuclear Engineering and Design*. Volume 387, February 2022.

5 Microsoft at CERAWeek: Accelerating digital transformation for a sustainable energy future, by Darryl Willis, Microsoft Corporate Vice President, Worldwide Energy Industry, published March 3, 2022.

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