

EERE-VTO T2M Project Final Report - Ideation of a Novel Commercialization Model

Office of the Director

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EERE-VTO T2M Project Final Report

Ideation of a Novel Commercialization Model

AOP # 8.3.1.001

Submitted by:



Jeffrey P. Chamberlain, Ph.D.
Director, Argonne Collaborative Center for Energy Storage Science

Date: May 3, 2016

1.0 Introduction

The Department of Energy Technology Transfer mission is to expand the commercial impact of DOE's portfolio of R&D activities, providing ongoing economic, security, and environmental benefits for all Americans. To advance this mission, Argonne National Laboratory has executed this Technology-to-Market (T2M) project funded by EERE-VTO. The objective of the project was to ideate an overall business model for a private entity with a mission to develop and deploy technology by identifying, de-risking, and moving scientific advances into commercial use.

2.0 Scope

This T2M project was built on eight years' experience understanding the strengths and weaknesses associated with licensing Argonne's EERE-VTO battery material discoveries to industry. Additionally, this project is informed by Argonne's collaborations with industry, both through direct research agreements and the BES-sponsored CEES EFRC and Joint Center for Energy Storage Research (JCESR). During execution of the project, staff developed the concept with guidance and advice provided by subcontractor experts (outside legal counsel, banking and investment consultants, and serial entrepreneurs). The concept was then further vetted through discussions with dozens of potential strategic stakeholders from industry and the financial investment community. The findings of this project are reported here; the key finding is that the model favored by stakeholders from both the public and private sectors is for an entity to be privately held, separate and independent from Argonne and other national laboratories. The T2M project also identified risks and mitigation strategies, described herein; Argonne consulted with DOE IP Legal regarding risks and mitigation strategies. With this project now complete, the private sector would need to fund any subsequent realization of the model through the formation of a private entity independent from Argonne.

3.0 Summary of the Proposed Model

The Power Point presentation included as Appendix 1 provides a description of the key attributes of the proposed model. The presentation illustrates the proposed model in the context of what may become the first implementation of the proposed model for an entity focused on energy storage technology, tentatively named "Volta." Although the concept for "Volta" is centered on energy storage, the proposed model could work for any number of technology areas where the so-called "valley of death" prevents or slows down the successful commercial deployment of early stage innovations. The proposed model bridges the valley of death by connecting: 1) end users and insight into market needs; 2) world-class R&D intellectual capital and facilities; 3) technical experts coupled with business analysts; and 4) length-minded investors with patient capital. This connection is facilitated by research agreements (e.g., Cooperative Research and Development Agreements) between the entity using the proposed model and DOE national laboratories and leading universities.

The proposed model also involves a five-stage maturation process in which emerging innovations are first identified by studying the research landscape and commercial marketplace, and then validated by working jointly with R&D partners to vet potential investment opportunities. This validation step requires only modest investments to verify the technological and business cases to decide whether to

invest more heavily to develop a given technology or business. More substantial investments would then be made to further develop the technologies and to demonstrate they are viable for commercial deployment. The efforts associated with identifying, validating, and developing the emerging technologies can all be done most effectively by partnering and establishing research agreements with DOE national labs and universities. This practice will de-risk technologies and is not currently employed by traditional venture capital firms, and also goes beyond the scope of most DOE-funded research. Entities using the proposed model would directly employ technical and financial experts that work together in teams (see Figure 1). These teams would only consider making the large investments needed to bring new products to market after following the de-risking steps. The end result is that the entity following the proposed model should be able to deliver attractive returns to its investors and the companies it has grown, while at the same time developing and deploying laboratory innovations into the market.

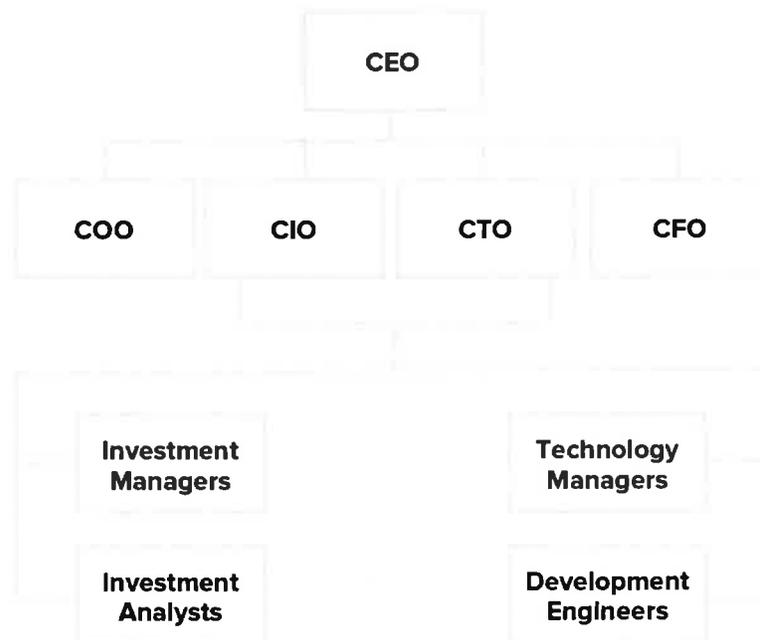


Figure 1

Another outcome of this T2M project is a set of proposed, theoretical relationships and flow of agreements that would exist during the operations of the entity. For example, before a CRADA could be established between the entity using the proposed model and a DOE national laboratory, terms such as U.S. competitiveness and general IP licensing terms would need to be negotiated. And when specific task orders are to be executed under the CRADA, the specific nature of the task orders would be subject to DOE review and approval before work could begin. Any laboratory-generated IP that may flow to the companies in which the entity invests would also be subject future negotiations.

4.0 Project Findings

Many valuable lessons were learned during the execution of the project:

- **Strong private sector interest.** The private sector has a strong appetite to better capitalize on the capabilities and the breakthrough research happening inside the DOE National Laboratories. Likewise the private sector recognizes that implementation of the proposed model might be beneficial to engage the labs and expedite the translation of scientific research and development into technology that is more ready for commercialization.
- **Privately held and independent.** Any entity that uses the proposed model should be completely independent from the federally-owned national laboratories. The national lab is focused on science for the public good; private-sector entities should focus on product development, and contract with the national lab(s) to answer specific scientific research and development questions. Both public and private interests strongly prefer such an entity to be privately-held, and separate from public, government ownership or interest.
- **Combine technical and financial expertise.** Any entity that uses the proposed model should adopt an organizational structure that includes a combination of technical and financial expertise to de-risk investment decisions.
- **Privately funded.** Any entity that uses the proposed model should be funded with private funds only; no reliance on public funding should be used at the start or during operation of such an entity.
- **Important to be a for-profit entity.** Any entity that uses the proposed model should be a for-profit entity. A preferred method to translate the national lab(s) scientific discoveries into products with impact on society is to operate in the sweet spot where technologies are identified and developed in a way that has both societal benefit and creates the opportunity for profit and associated job creation.
- **The entity should be focused on technology from a single field.** In order to ensure the interests of all stakeholders are aligned, the entity should clearly define and limit the breadth of the scope of technologies it considers.
- **Diversity among investors is important.** Any entity that uses the proposed model should garner investment from a diverse group of strategic-minded entities from multiple sectors that are impacted by a common technology (i.e. intelligent energy storage systems), as well as investors who have access to a channel to market and are interested in a financial return. This will increase the entity's probability of successfully developing profitable and impactful technologies and ensure that not one single entity or person has control of the enterprise, and as such, there will be checks and balances in the decision-making processes.

- **Corporate structure better than venture fund structure.** A corporate structure that provides an opportunity for strategic investors to sit on the board and/or investment committee of such an entity is preferred to the venture fund model in which the fund investors are limited partners and investment decisions are made only by the general partner. Insight into market end use should govern the operation.
- **All stakeholders should have aligned interests.** The entity's investors, employees, and the contracted labs all share a desire to successfully develop and deploy impactful energy technology. The organizational structure of such an entity should be designed so that each party is incented in the appropriate way. For example, the entity needs to be organized and operated in such a way that when the technology is manufactured and deployed, contracted laboratories advance their mission to catalyze the timely, material, and efficient transformation of the nation's energy system and secure U.S. leadership in clean energy technologies, the investors will experience their desired return, and employees of the entity see their impact and share in the return.
- **Consider other committees in addition to a board.** The entity should consider establishing a committee to manage early-stage research decisions that is controlled by internal management, and a committee comprised, in part, of the investors that is charged with making large investment decisions. In addition, external advisory committees should be formed that are not empowered to manage the operation.
- **Domestic investment preferred.** Any entity that uses the proposed model should remain, as much as possible, funded by U.S. interests. This will create the opportunity for a stronger relationship through research contracts, once negotiated, between such entity and the national labs.
- **No joint appointments.** Any entity that uses the proposed model should not have joint appointments with the national labs. This will allow for greater independence, and reduce the chances of conflicts of interest.
- **Relationships with multiple national labs recommended.** Any entity that uses the proposed model should be open to establishing research contracts with more labs than Argonne alone. This will enable such entities to tap into the broadest base of capabilities and technologies possible.
- **Non-exclusive relationships important.** The relationship between any entity that uses the proposed model and the national labs should be non-exclusive. By remaining non-exclusive, the national labs will remain open to other avenues to commercialization; this will afford the national labs flexibility in disseminating innovative research into the public.
- **Relationships with research entities other than national labs.** Any entity that uses the proposed model should identify, validate, and develop commercial-ready technology from multiple research entities, including both national labs and universities.

5.0 Risks and Mitigations

- **Institutional Conflicts of Interest.** Entities using the proposed model will be independent, with no special status with Argonne or other DOE National Laboratories; neither Argonne, UChicago Argonne LLC, nor UofC, will be a member of or have a seat on the Board of Directors of any entity utilizing the proposed model.
- **Individual Conflicts of Interest.** Employees leaving to launch an entity using the proposed model will separate under Argonne's entrepreneurial leave policy with an associated DOE-approved COI mitigation plan. Any exclusive licenses between Argonne and such an entity will require an additional COI plan and DOE approval.
- **Foreign Interactions/Funding.** Any entity that utilizes the proposed model should plan to use investments only from domestic sources. If an entity were to accept any foreign investment it would need to provide disclosure to Argonne and DOE, and be subject to the terms of any agreements between DOE and any entity that uses the proposed model.
- **Fairness of Opportunity.** A final report for the T2M project will be made public and anyone can implement the model. Also, Argonne has had dozens of interactions with industry and the public regarding this model; as such, the motivations for the proposed model and the model itself have been made widely available.
- **Perception of picking winners.** Argonne will maintain a non-exclusive relationship with any entity that utilizes the proposed model. Argonne will remain free to work with other entities; any entity that uses the proposed model would have no special status.
- **An entity that uses the proposed model fails.** Being fully privately funded, there is no federal money at risk. At the conclusion of T2M research project, Argonne would have a hands-off relationship with any entity that uses the proposed model.
- **Potential perception of misuse of government funds.** DOE funds have been used only to study the possible models for forming a privately-held entity, and theorizing a best model for such an entity, taking into account perspectives from multiple stakeholder groups. No government funds have been used to execute on such a model, nor will they be.
- **Potential perception that Argonne has raised private capital for an outside entity.** Argonne has developed, discussed, and vetted the proposed model with many private interests, including people in the investment community. The purpose and content of those discussions have focused wholly on getting feedback on the model.
- **Perception that a CRADA is already promised to whoever executes the proposed model.** No negotiations on a CRADA have occurred. Argonne has been repetitively explicit in all communications that any such CRADA would have to be negotiated following normal approval process, and that there are no guarantees of success for such a negotiation. Further, such a negotiation can only commence after an entity exists that would follow the proposed model.

6.0 Conclusion

This T2M project built upon work dating back to 2007, when Argonne began licensing materials developed through EERE-VTO sponsorship for advanced lithium-ion batteries to industry. In June 2014 the Secretary of Energy Advisory Board (SEAB) met at Argonne and discussed lab tech transfer practices and made a decision to seek an improved or novel interface between the private sector and the national labs. The proposed model theorized during this project is a novel and improved approach. Industrial entities and the financial community have expressed an interest in the proposed model. If a launch occurs, the national labs would then negotiate in good faith research contracts with that entity in order to fully realize the potential impact the proposed model could deliver.

VOLTA CONCEPT

VISION | MODEL | STATUS

JEFF CHAMBERLAIN

Director, Argonne Collaborative
Center for Energy Storage Science

VOLTA T2M PROJECT – AN OVERVIEW

Background

- Consistent with the DOE mission of impact through the development and transfer of energy technology, and in response the SEAB's stated desire to improve the laboratory/industry interface, DOE-EERE VTO funded a Technology-to-Market (T2M) project at Argonne to develop an innovative model to increase the impact of research and expedite the transition of innovations into commercial products. We call the potential outcome of this research project the "Volta Model."
- The proposed model leverages industry insight, with private capital and access to world class facilities (like the DOE National Labs) in a new way that will help accelerate the impact of federal R&D investments.
- While conception of the proposed model was federally funded, implementation of the model will be entirely privately funded and independent from ANL and/or DOE.

Status

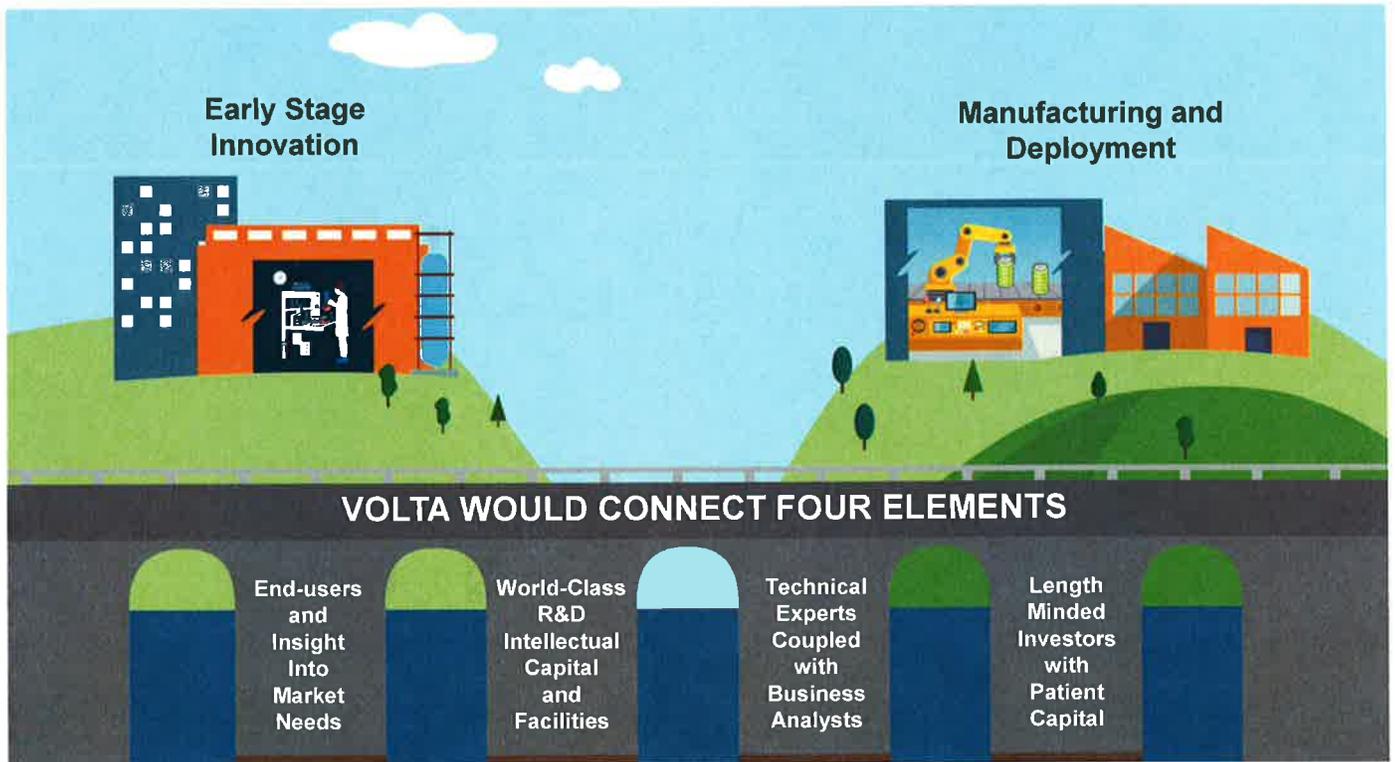
- The T2M project at Argonne is nearing completion and will culminate in a final report that will describe a business proposition and model (including recommended legal structures and operating agreements). This model can be implemented by independent private entities interested in accelerating the commercial deployment of promising energy technologies. This final report will be publicly available for anyone to use.
- Over the course of our research project, several private-sector stakeholders expressed interest in participating in an entity that might execute the proposed model and one industrial stakeholder has approached Argonne with the desire to seed-fund and launch such an operation.

Next Steps

- ANL will finish the T2M project and issue a final report in Spring 2016.
- Any entity that decides to implement the proposed model can approach Argonne and/or other National Labs to negotiate a CRADA or other technology transfer agreement consistent with DOE and Lab policies and procedures.

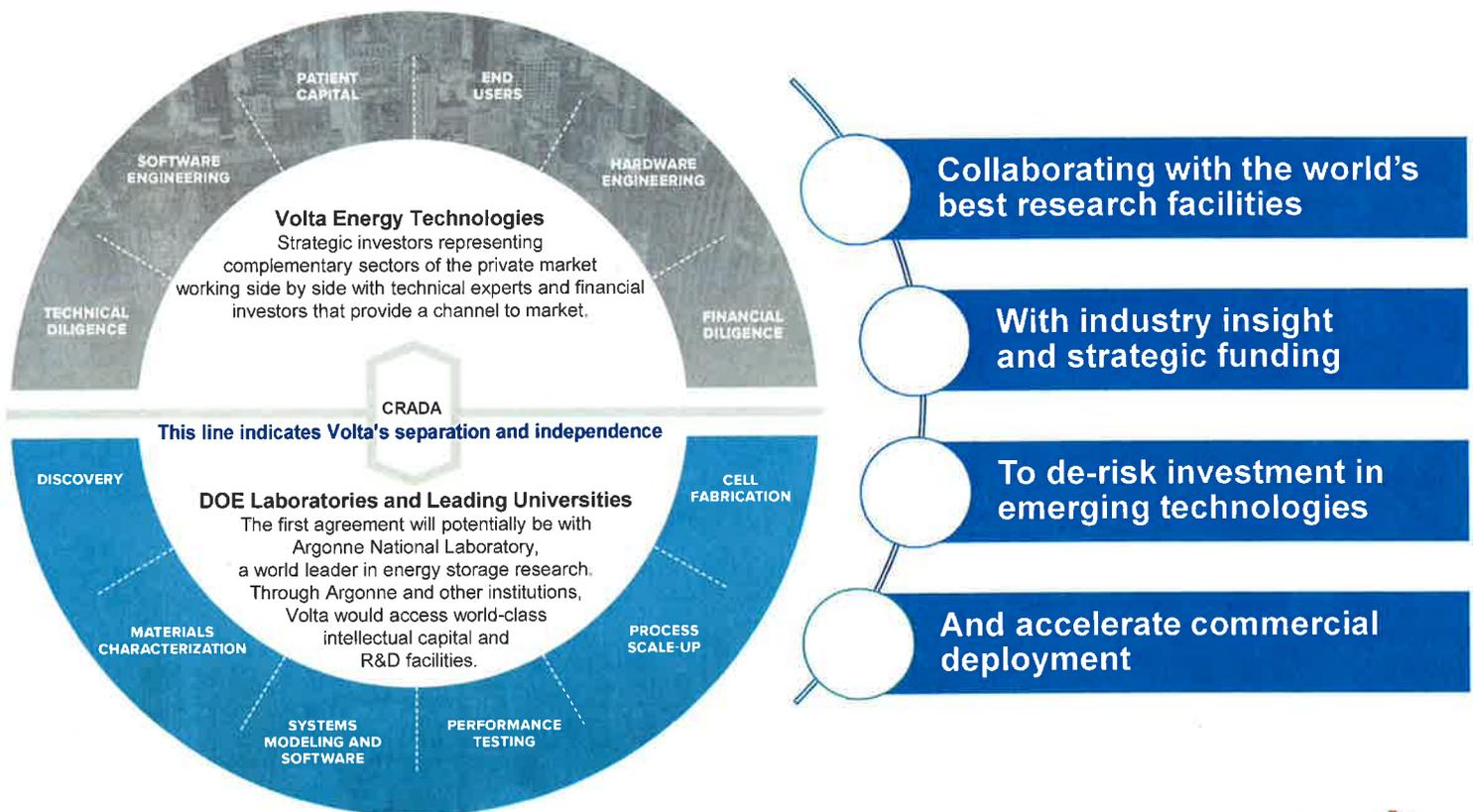
THE PROPOSED MODEL WILL SERVE AS A BRIDGE

Federal investment in early-stage research faces a valley of death. The proposed model will help bridge this valley by connecting four critical elements that will accelerate development and deployment of promising energy technologies



VOLTA ENERGY TECHNOLOGIES WILL LIKELY BE THE FIRST IMPLEMENTATION OF PROPOSED MODEL

Described here for illustrative purposes

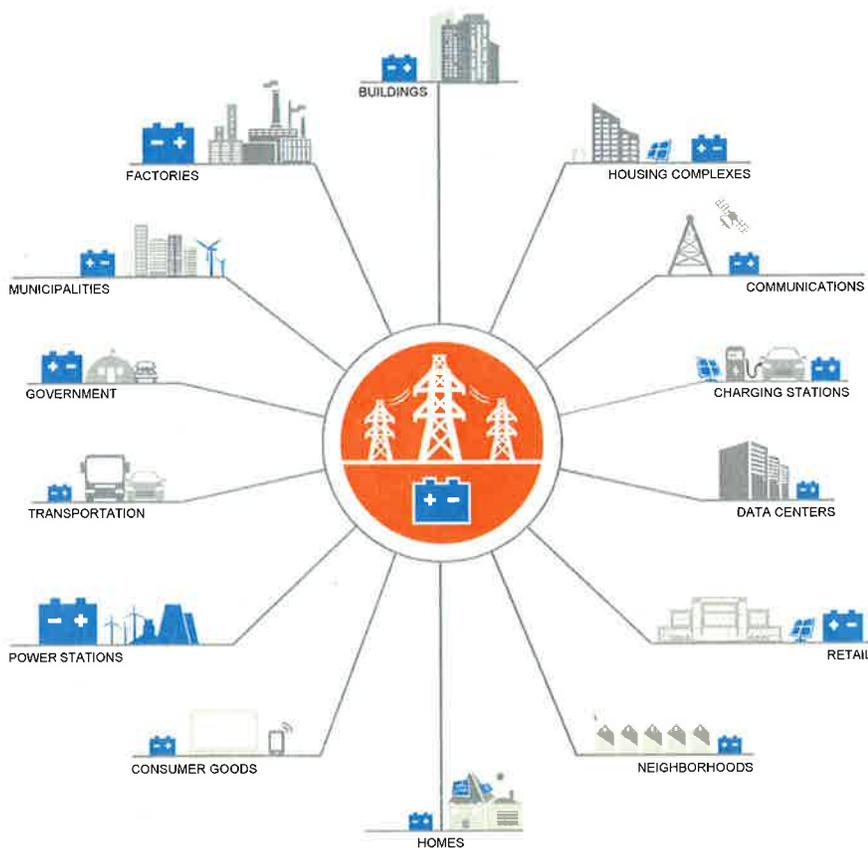


VOLTA WOULD DEFINE AND DEVELOP INTELLIGENT ENERGY STORAGE SYSTEMS

Future intelligent storage systems will be comprised of sensors, electronics, chemistry, and software that communicate and control how electricity resources are consumed on a personal and macroscopic level. Volta would identify, develop, and integrate these component technologies.



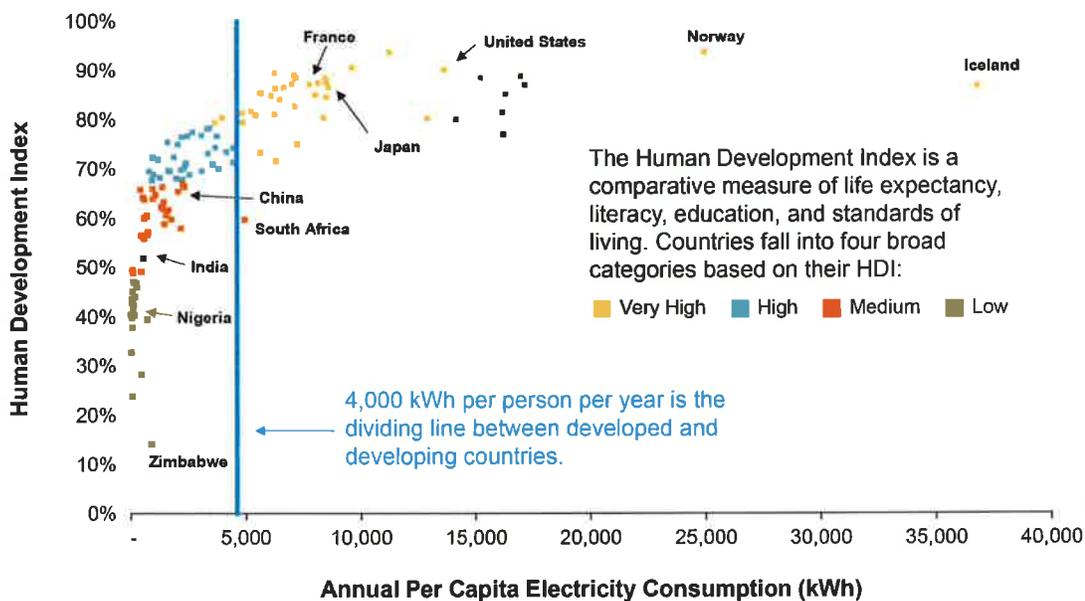
VOLTA'S OUTCOMES WOULD ENABLE AN INTERCONNECTED GRID OPERATION



- Application-specific energy storage systems will communicate with one another and the broader energy system to deliver their services when they are needed most.
- Energy storage systems integrated across applications will predict, monitor, and respond to user behavior, the environment, and the market.
- Electricity will be purchased and stored when it is least expensive, and dispatched when costly to generate, thereby maximizing the value of the stored energy.

VOLTA'S ENERGY STORAGE SYSTEMS WOULD OPEN THE WORLD MARKET FOR DISTRIBUTED GENERATION AND ACCESS TO ELECTRICITY

Effective and inexpensive solar technology coupled with intelligent energy storage systems will be the building blocks from which to form connected microgrids in the developing world.



- Clean energy coupled with energy storage is the best path forward that will allow continued human development without severe environmental consequences.
- The science and technology are coming together with the need.

Source: Human Development Index – 2010 data United Nations; Annual Per Capita Electricity Consumption (kWh) - 2007 data World Bank

VOLTA'S PROCESS WOULD COMBINE TECHNICAL DILIGENCE AND DEVELOPMENT WITH MARKET INTELLIGENCE AND FINANCIAL DILIGENCE

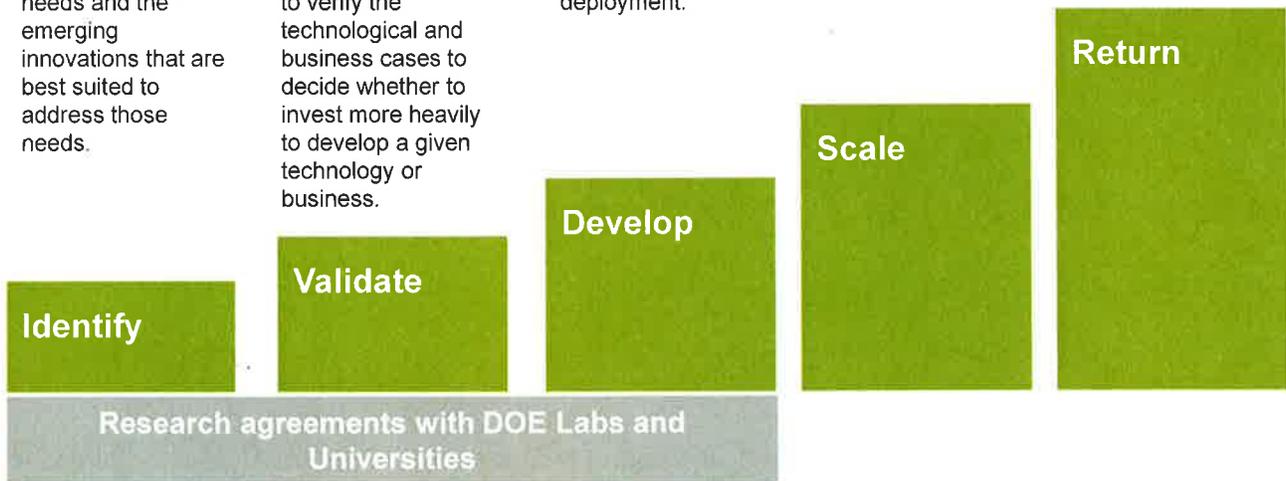
Study the commercial marketplace and partner with an extensive network to identify end-user needs and the emerging innovations that are best suited to address those needs.

Work jointly with R&D partners to vet investment opportunities, making modest investments to verify the technological and business cases to decide whether to invest more heavily to develop a given technology or business.

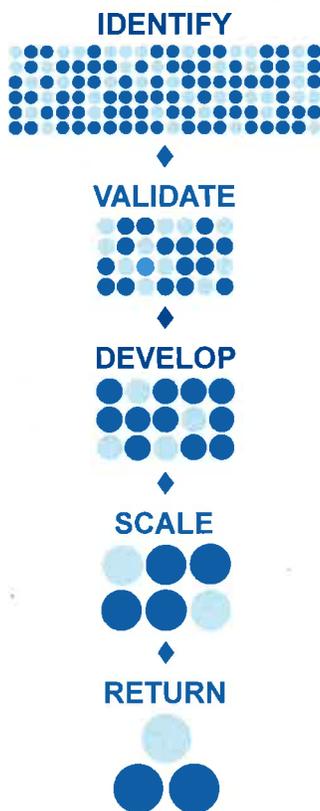
Make the more substantial investments required to seed, develop, and demonstrate viable commercial deployment.

Make the large investments needed to bring new product to market.

Deliver attractive financial returns to investors and the companies Volta has grown.



VOLTA WOULD DE-RISK INVESTMENTS AT ALL STAGES OF TECHNOLOGY DEVELOPMENT



Pre-investment stage. Hundreds of opportunities – evaluated by Volta for both technical and market feasibility before proceeding to the validation stage.

Small investment. Emerging technologies tested on key performance variables and subjected to economic modeling. Positive results warrant further development.

Mid-level investment. Further validation, scale-up testing, prototyping, and pilot manufacturing.

Large investment. Increase manufacturing capability to commercial scale.

Return on investment. By developing and investing in impactful technologies, deliver attractive returns to Volta's investors and its affiliated companies.

POTENTIAL CRADA WITH NATIONAL LABS

TO BE NEGOTIATED IN THE FUTURE

- There will be no initial transfer of IP to an entity using the Volta model. Future IP licensing terms are to be negotiated.
- U.S. Manufacturing requirements of any CRADA and/or license agreement (to be negotiated in the future) will follow Lab Generated IP through its entire life cycle even if the IP is transferred to a third-party or if the Volta Model Entity and/or one of its Startup Companies is acquired by a third-party.
- All Lab tech transfer agreements (and task orders) will be subject to DOE review and approval.
- The model contemplates that all funding will be domestic and if foreign funding is ever contemplated it will be disclosed to both the Lab and DOE for appropriate review.

PROPOSED MODEL TO COLLABORATE WITH NATIONAL LABS TO VALIDATE & DEVELOP PROMISING TECHNOLOGIES

POTENTIAL VOLTA MODEL ENTITY
100% Private Capital

- Team of Technical and Financial Professionals
- Capital from Strategic and Financial Investors

MARKET

- Impact through Customer Adoption
- Returns

STARTUP COMPANIES
(e.g. Chemistry, Sensors, Electronics, and Software)

Deploying Next Generation of Technology

Capital Investments
(in exchange for ownership stake)

Funding for validation & development of promising technologies (e.g. through a future negotiated CRADA)

No transfer of IP to Volta initially. Future IP Licensing terms to be negotiated.

NATIONAL LABS

IP

- U.S. Manufacturing requirements of any CRADA and/or license agreement (to be negotiated in the future) will follow Lab Generated IP through its entire life cycle even if the IP is transferred to a third-party or if the Volta Model Entity and/or one of its Startup Companies is acquired by a third-party
- All Lab tech transfer agreements (and task orders) will be subject to DOE review and approval
- The model contemplates that all funding will be domestic and if foreign funding is ever contemplated it will be disclosed to both the Lab and DOE for appropriate review

STATUS OF THE TECHNOLOGY-TO-MARKET PROJECT



The research phase coming to an end; funded by DOE

- Operating strategy and process identified
- Preferred structure and governance outlined

The seed phase nearly ready to start; requires funding by private sector

- Private sector must now commit capital and mind-share
- Commitment is required to execute seed phase, and to prepare for operation phase
- Seed phase could last 12 months; aim for operations is 10 years

POTENTIAL DOE ISSUES/CONCERNS AND MITIGATING FACTORS

| Potential Issue | |
|---|--|
| Organizational Conflict of Interest (OCI) | <ul style="list-style-type: none"> An entity using the Volta model would be an independent entity. Neither Argonne, UChicago Argonne LLC, nor UofC would be a member of an entity using the Volta model. Neither Argonne, UChicago Argonne LLC, nor UofC would have a seat on the Board of an entity using the Volta model. |
| Personal Conflict of Interest (COI) | <ul style="list-style-type: none"> Employees leaving to launch an entity using the Volta model may separate under ANL's entrepreneurial leave policy with an associated DOE-approved COI mitigation plan. Any exclusive licenses between ANL and such an entity will require an additional COI plan and DOE approval. |
| Fairness of Opportunity | <ul style="list-style-type: none"> A final report for the T2M project will be made public – anyone can implement the model. ANL has also documented dozens of open interactions with industry and other groups. |
| Foreign Interactions/Funding | <ul style="list-style-type: none"> An entity that utilizes the Volta model should plan to use investments only from domestic sources. If an entity that utilizes the Volta model accepts any foreign investment it would need to provide disclosure to ANL and DOE. |
| Use of Government Funds | <ul style="list-style-type: none"> EERE T2M funds were used to fund research to develop the Volta concept. No DOE funds will be used to launch and/or operate any entity that uses this model. |
| U.S. Competitiveness | <ul style="list-style-type: none"> U.S. Manufacturing requirements of any CRADA and/or license agreement (to be negotiated in the future subject to DOE approval) will follow Lab Generated IP through its entire life cycle even if the IP is transferred to a third-party or if the Volta Model Entity and/or one of its Startup Companies is acquired by a third-party. All Lab tech transfer agreements (and task orders) will be subject to DOE review and approval. The model contemplates that all funding will be domestic and if foreign funding is ever contemplated it will be disclosed to both the Lab and DOE for appropriate review. |
| Preferred Access | <ul style="list-style-type: none"> No preferred access to DOE Labs. 3rd parties will continue to be free to interact directly with National Labs. The relationship between an entity using the Volta model and National Labs will be nonexclusive. No priority of access or guarantee that work will be accepted by the Labs. No guarantee of a CRADA or SPP; DOE Labs will treat entities using the Volta model like any other potential non-DOE research sponsor. |
| Concept v. Implementation | <ul style="list-style-type: none"> T2M project will wrap up and final report will be issued. Implementation of the Volta Model will be privately funded and independent from the Lab ANL did not seek private investment during the T2M project; however, one industrial entity was so intrigued with the proposed model that it approached ANL about being the seed investor to an entity that might implement the Volta concept. |



Thank you



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Argonne National Laboratory
9700 South Cass Avenue, Bldg. 205
Argonne, IL 60439

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