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Potential Analysis of Cluster Ecosystems in Switzerland

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Zusammenfassung

Die Global Cleantech Cluster Association/GCCA (www.globalcleantech.org) umfasst 53 Cluster in 29 Ländern mit über 10'000 Firmen. Ein GCCA Fokusthema ist die Entwicklung eines neuen Finanz-Mechanismus, welcher langfristig orientierten institutionellen Investoren wie zum Beispiel Pensionskassen die skalierbare Investition in nachhaltige Firmen erlauben soll und dabei die gegebenen Risiko- und Rendite-Erwartungen berücksichtigt.

Gemeinsam mit Corymbus Inc. aus Ann Arbor/Michigan ist das Konzept des Multi-Asset Renewal Fund (MARF) entwickelt worden. Mit MARF Programmen werden multinationale Firmen, KMUs und Startups entlang von ausgewählten Wertschöpfungsketten analysiert und in einem Portfolio mit mehreren Dutzend Firmen strukturiert. Das erste MARF Programm wurde 2013 in Finnland als Pilot lanciert.

Die Potentialanalyse von Cluster Ecosystems erlaubte die Analyse - auf der Makro-Ebene - von zwei erfolgversprechenden Wertschöpfungsketten: Smart Grids und Smart Mobility. Als Folgeschritt können jetzt mit privaten institutionellen Investoren die Umsetzung der Phase II eines MARF Programms (Mikro-Ebene Analyse) und der Phase III (Fund Strukturierung) diskutiert werden.

Als Projektmodul wurde das 1. Fintech Cleantech Forum im November 2016 in Zürich mit 32 ausgewählten ExpertInnen realisiert. Der Multi-Stakeholder-Dialog führte u.a. zu folgenden Erkenntnissen:

- Der Finanzplatz Schweiz positioniert sich neu, Digitalisierung ist zu integrieren
- Die Erneuerung der Energieinfrastruktur ist ein Milliardenmarkt, der auch für private Investoren interessant ist
- Pensionskassen müssen alternative Investment Opportunitäten entwickeln

Diese Kombination ist eine historisch einzigartige Ausgangslage. Die Projektresultate ermutigen, die Synergien zwischen MARF Programmen und der marktwirtschaftlichen Finanzierung der Energiestrategie 2050 gezielt strategisch weiterzuentwickeln, sowie regulatorische und politische Rahmenbedingungen zur Unterstützung dieses Transformationsprozesses vertieft zu analysieren.

Résumé

La Global Cleantech Cluster Association/GCCA (www.globalcleantech.org) contient 53 clusters dans 29 pays, qui représentent 10'000 entreprises. Un des thèmes prioritaires de GCCA est le développement d'un nouveau mécanisme financier, qui permet à des investisseurs institutionnels à long terme, comme par exemple des caisses de pension, d'investir dans des entreprises durables en tenant compte du risque et du rendement.

Le concept des Multi-Asset Renewal Fund (MARF) a été développé avec Corymbus Inc. d'Ann Arbor/Michigan. Avec un programme MARF, des entreprises – grandes entreprises, PME, start-ups – sont analysées le long de chaînes de valeur choisies et inclus dans un portefeuille avec quelques dizaines d'entreprises. Le premier programme MARF a été lancé en Finlande en 2013.

Dans le cadre de l'analyse de potentiel pour les écosystèmes de clusters, deux chaînes de valeur prometteuses ont été analysées (au niveau macro) : Smart Grids et Smart Mobility. Dans une prochaine étape, la réalisation de la 2ième phase d'un programme MARF (analyse au niveau micro) et de la 3ième phase (structuration d'un fonds) peut être discutée avec des investisseurs institutionnels privés.

Un élément de ce projet a été la réalisation du premier « Fintech Cleantech Forum » en novembre 2016 à Zurich avec 32 experts choisis. Cet événement a conduit, entre autres, aux connaissances suivantes :

- La place financière suisse se positionne différemment et doit intégrer la numérisation
- L'infrastructure énergétique doit être renouvelé et exige des milliards d'investissements privés
- Les caisses de pension doivent développer d'autres opportunités d'investissement

Cette combinaison offre un départ historiquement unique. Les résultats du projet encouragent de développer les synergies entre les programmes MARF et le financement de la stratégie énergétique 2050 de manière stratégique, et d'analyser en détail comment la politique peut supporter ce processus de transformations.

Summary

The Global Cleantech Cluster Association/GCCA (www.globalcleantech.org) includes 53 Cluster partners in 29 countries, representing 10,000 companies. Since 2010, a GCCA focus is to develop new financial mechanisms enabling large-scale commercial deployment of low carbon technologies. Goal is to provide an investment alternative at appropriate risk and return expectations for institutional investors, e.g. pension funds. As a solution the Multi-Asset Renewal Fund (MARF) programs were developed in collaboration with Corymbus Inc. from Ann Arbor/Michigan.

The MARF is a novel investment fund instrument that will pool capital commitments of large institutional investors into thematic, cluster ecosystem-based multi-asset funds to fuel the renewal and growth of the real economy while providing attractive returns for the investors. In 2013, the first MARF Program was launched as a pilot in Finland.

The Potential Analysis of Cluster Ecosystems allowed (on a macro-level) to analyze two emerging cluster ecosystems in Switzerland: Smart Grids and Smart Mobility. Based on the successful project results, discussions with private Swiss stakeholders and institutional investors are now deepened to explore the opportunities for a MARF Program Phase II (micro-level) and Phase III (fund structuring).

In addition, the first Fintech Cleantech Forum in Switzerland was realized in November 2016 in Zurich with 32 selected experts. Key outcomes of the Forum include:

- Switzerland is in a repositioning process as a world leading financial hub
- The renewal of the Swiss energy infrastructure is a multi-billion market providing opportunities for private investors
- Pension funds need to develop alternative investment opportunities

This unique situation is a historic opportunity and invites the involved stakeholders to further explore potential synergies of the MARF and Energy Strategy 2050 in a pro-active strategic manner, and to analyze in detail how regulatory frameworks could best support this transformation process.

Content

1. Potential Analysis of Cluster Ecosystems and Multi-Asset Renewal Funds (MARF)

In the nutshell, the Multi-Asset Renewal Fund (MARF) is a novel investment fund instrument that will pool capital commitments of large institutional investors into thematic, cluster ecosystem-based multi-asset funds to fuel the renewal and growth of the real economy while providing attractive returns for the investors. The MARF differs from existing financial instruments in a number of ways that beg further elaboration. Let us decompose the elements of the MARF approach one by one.

Institutional investors need more efficient instruments to funnel investments into the growth of the real economy

Institutional investors, here, refer to organizations such as pension funds, insurance companies, private wealth managers, sovereign wealth funds and large family investment offices. These institutions control and manage tremendous financial assets for various purposes, including meeting fiduciary duties, providing protection from losses, and generating financial returns, depending on the individual investor's mandate. To provide an idea of sheer scale, in 2014 pension funds in OECD countries alone managed investment assets in the total amount of USD 25 trillion. In comparison, the GDP of the EU economies in 2014 added up to only USD 18.5 trillion[1]. Insurance companies add another mind-boggling USD 13 trillion to the global assets under management.

Unfortunately, most of the capital committed by institutional investors today has little impact in the real economy; it does not directly contribute to the renewal of industries or the generation of new jobs. Investments are made within the confines of the financial markets – the financial economy – via indirect instruments, such as stocks and derivatives, that do not allow the underlying companies in the real economy to draw on the investments as a financial resource for growth. In contrast, more direct investment strategies, such as investments into private equity funds or corporate bonds that mediate the investments into companies, do have an impact on the real economy. However, particularly private debt and equity are a relative rarity in the investment strategy portfolios of institutional investors.

As a result, small and medium-sized companies (SMEs), for instance – which provide 67% of the total number of jobs in the EU and create 71% of new jobs[2] – have only very limited access to institutional investment capital as a resource for renewal. This investment gap is exactly where we see vast opportunities for game-changing innovations in the design of financial instruments. Just imagine the economic impact of an investment vehicle that would allow leveraging the capital commitments of large institutional investors in the real economy for the renewal of incumbent industries and the growth of emerging ones. The MARF was developed to answer to the call.

You might ask why institutional investors have limited interest in the real economy. If venture capitalists, banks and business angels have been able to spot and exploit the opportunities, why haven't institutional investors acted on them? The answer is at least twofold. First, investing into the real economy – one company or even a portfolio of private companies at a time – has simply been too inefficient on the required scale. Given the vast assets under management and the considerable transaction costs related to the execution of an investment transaction, the minimum ticket size – i.e. the minimum amount of capital invested at any one time by an investor – ranges between USD 50 million and USD 500 million. That is a

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[1] World Bank: http://data.worldbank.org/region/EUU

[2] Eurofound (2016). ERM annual report 2015: Job creation in SMEs, Publications Office of the European Union, Luxembourg.

lot more than a single portfolio, much less a single company, can absorb at a time. Indirect instruments such as stocks are much easier to bundle into large enough portfolios because their markets are highly developed. Information on stocks and derivatives is transparent and available, and the purchase and sales transactions are highly efficient – no matter the volume – thanks to advances in information and communication technology.

As to the second reason, direct investments into private companies are a lot more illiquid than indirect investments. It takes longer for private investments to generate returns because they are a function of the rise in value of the company, or servicing of its debt obligations. The value, in turn, only rises with the growth and progress of the business of the invested company. Therefore, capital committed via direct investments needs to be patient and wait for the rise in company value before returns can be expected. However, institutional investors want to maintain their flexibility and be able to redirect capital at will. Since the invested capital in illiquid assets can't be traded or withdrawn, investors demand an additional liquidity premium on their investments, if they are to invest to begin with.

If one wants to implement an investment vehicle that leverages institutional investment capital for direct impact in the real economy, one must be able to address these inefficiencies. Solving the issue is one of several financial innovations that MARFs introduce vis-à-vis existing instruments. MARFs combine a large enough pool of liquid and illiquid financial instruments in a single vehicle so that they provide both for economic impact, as well as sufficient scale and flexibility to institutional investors.

The centers of today's economic growth and renewal are in thematic and clustered ecosystems

Investment impact is strongly correlated with thematic growth sectors of the economy. To see the connection between the two concepts, one first needs to establish how modern industries evolve and grow. Modern growth sectors of the economy are characterized by newly evolving collaborative relationships across conventional industry boundaries. For instance, take Smart Grids, a supply- and demand-side innovation to optimize energy delivery and consumption. To integrate predictive, autonomous, and user-guided intelligence into the production, distribution and consumption of energy, energy utilities and grid operators are now actively liaising with industry sectors they previously had no dealings with. These include – but are not restricted to – telecommunications operators, data analytics companies, smart meter manufacturers, system software providers and mobile application developers. It has become clear that many growth sectors of the economy can no longer be properly characterized using conventional industry classifications. On the contrary, never have such a large number of previously unrelated and diverse industry sectors joined forces to create entirely new types of value-added. Never have value chains and value networks been this complex and diverse.

If not a certain industry classification, what then is the common denominator for a given emerging ecosystem? To put it simply, it is the defining activity of the ecosystem in and by itself; an activity that shares a common theme such as Smart Grids, Smart Mobility or Green Chemistry. They are characterized by cross-industrial value chains and can best be described by their common thematic activity.

Given that thematic ecosystems are the current growth centers of the economy, an investment vehicle that allows for aligning institutional capital commitments with the emerging structures of new industries constitutes a major financial innovation with unprecedented economic impact potential. Indeed, many existing investment strategies, by design, are incapable of driving major economic growth. In the name of risk management, most investment strategies prefer to diversify portfolios across a broad palette of unrelated industries, protecting investments from losses in any single sector. For an investor interested only in maximizing monetary returns this is a viable strategy, of course. There is no need to consider whether the investments help to build out the economy.

However, for someone interested in promoting economic growth – say, the world's 80 largest pension funds (P80 Group) that have committed 3% of their assets under management (AUM) to promoting green economic growth through infrastructure or project finance – it is awfully ineffective. Thematically agnostic investment strategies spread capital commitments too thinly across various ecosystems to have impact on economic development. Therefore, the development work behind MARFs had the objective to ground its investment thesis in sourcing investment deals from identified thematic industry ecosystems.

MARFs employ a data-driven approach to ecosystem identification and mapping

To identify and depict the scope and scale of any thematic ecosystem, MARFs revert to a highly data-driven approach. The process starts with mapping the fundamental economic structure of the ecosystem: Who are the key actors in the ecosystems and how do they interact with each other?

Industrial structures, fundamentally, are chains and networks of financial and transactional interactions between companies. These include supplier-client relationships, joint ventures, alliances, and R&D collaborations. Independent of the nature of interaction, the relationships involve business transactions between two or more companies and can, in most cases, be quantified by the volume of monetary or resource flows.

In alignment with Porter's[3] concept of the value chain, the configuration of these relational patterns and the variety of functions that companies provide to each other characterize the structural boundaries and the thematic value added of any given industry ecosystem. In today's globalized economy, value chains are many times interlinked across conventional industry boundaries to form networks of cross-industrial value chains. It is these networks of interaction that we refer to as ecosystems. Therefore, to find proof of existence for any given emerging ecosystem, one needs to uncover transactional and financial network relationships between the companies that are active therein.

Many methodological alternatives exist. The classic approach involves the use of input-output tables that show quantified value flows between industry sectors and are based on annual industry accounts. The data in the tables are highly aggregated, however, available mostly on the two-digit industry classification level. Mapping ecosystems at such low resolution will not truly lead to any applicable insights with regard to the nature of businesses that, in the end, define the theme of the ecosystem. Therefore, MARFs revert to much more granular data on the individual company level – such as Bloomberg's SPLC (Supply Chain) Module or Factset's Revere Database, both relatively new services, which provide company-specific information on customers, suppliers, and competitive relationships with peers. For each relationship in the database it is possible to retrieve quantitative information on the estimated monetary flow and its direction between any two involved companies. Furthermore, each company is assigned an industry code in a number of different industry classification systems (GICS, BICS, NAICS, NACE, etc.), a feature that allows for aggregation of data from the company level to the industry level when necessary. As the design of a MARF necessitates insights on which specific industries play important roles in the emergence of new ecosystems, this is a very handy feature indeed. Furthermore, the data can be retrieved for any pre-specified geographic region – regional, national, continental or global – allowing for the design of a MARF according to specific geographic interests, if necessary.

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3 Porter, M.E. (1985). Competitive Advantage: Creating and Sustaining Superior Performance. New York.: Simon and Schuster.

MARFs implicitly diversify risk across many industry sectors and company profiles

How do MARFs deal with risk then, you might ask? Doesn't the focus on thematic ecosystems introduce systematic – correlated, or non-diversified – risks that are difficult to offset? The short answer is: no. Thematic ecosystems are a collaborative network of companies from a great number of different industries. For most of these companies, their activities in any single thematic ecosystem comprise only a fraction of their other existing or potential markets. One could consider each ecosystem the companies are active within a separate market or line of business. Many of the companies – such as telecommunications operators and application software developers – are active in a number of different ecosystems. Systemic market risks will not impact each industry in the same way. In investment parlance, there is low correlation or a high degree of diversification across the portfolio of companies included in a thematic fund. Hence, the cross-industrial nature of thematic ecosystems provides for an implicit risk diversification strategy.

The multi-asset fund structure matches the right asset classes with the right companies

Identifying and understanding the industrial structure of thematic ecosystems is insufficient to execute a thematic investment strategy, and allocate investment capital to specific companies. Especially more direct investments in private companies – such as unsecured risk debt and private equity – necessitate assessing the ecosystems on the company-level. One needs to understand the risk of the underlying assets. The challenge here is the vast diversity of companies. Thematic ecosystems are cross-sectoral, providing for a great variety of businesses in the different industrial spaces of the ecosystem. Not only do companies vary in their industrial backgrounds, they also differ in size, stage of life-cycle, business and revenue models, capital intensity and many other characteristics that investors deem important when assessing a company. These characteristics determine the financial needs of a company and its fit with the various investment instruments that exist on financial markets.

A young, pre-revenue startup cannot expect to be able to secure a bank loan to fuel its growth because there is no cash flow to cover the fixed installments of the loan. Likewise, most large enterprises are not able – nor willing – to attract private equity investments because its growth and the scalability of business are not on par with the investors' expectations. Consequently, to effectively promote the growth and renewal of an entire thematic ecosystem, through the multi-asset structure MARFs tailor financial solutions to each individual company type; be it a startup, small and medium-sized enterprise (SME), or a large corporate entity. It would need to combine the respective types of capital – risk debt, private equity, corporate and SME bonds and stocks – within a single, thematic fund.

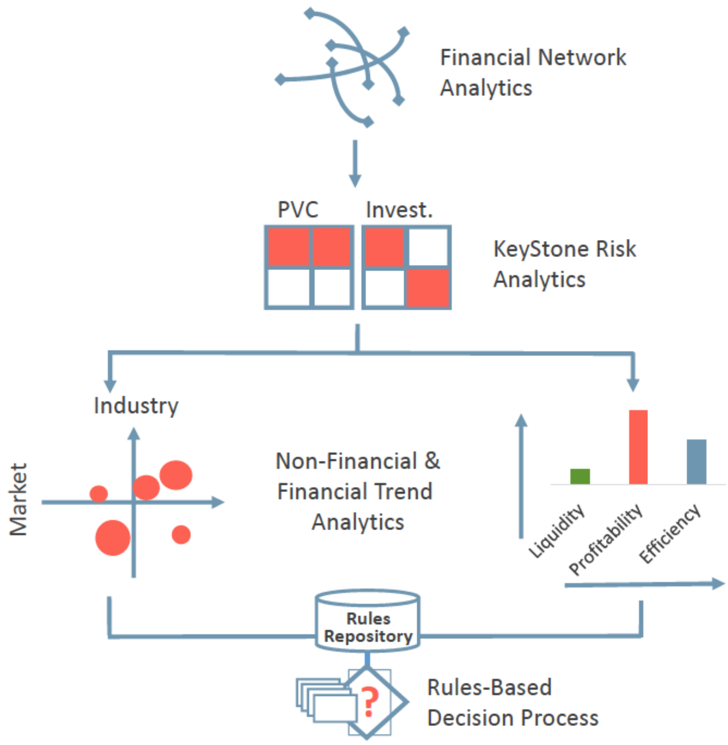
Risk-Return Modeling

A risk-rating strategy was developed for Multi-Asset Renewal Funds (MARF) in general, and tested using a specific fund application – focused on the smart mobility industry. The strategy was designed to fit within the risk-return assessment screens used by institutional investors. Hence, the task was to adapt the MARF to allocation principles such as specified under the broadly used Capital Asset Pricing Models common place in the financial industry.

Selection of the Investment Universe
Remember that financial network mapping tools - Bloomberg and Factset input data – were used to structure the industry's anchor and catalyst industry segments. The relevant companies and associated projects were sourced using the industry classification codes of the specified segments. Lastly, the financial asset selection for the Fund's asset segments was based on a two-tiered strategy followed by a rules-based decision engine (see Figure):

1. KeyStone Compact® analysis of forward-looking unstructured (non-financial) risk metrics (management, market, industry), and
2. Traditional financial analysis of lagging data (liquidity, profitability, efficiency).

Figure 1. Rules-based asset allocation process based on non-financial and accounting metrics. Source: Adriaens, P. and A.-J. Tahvanainen. 2016. [4]



Legend: PVC: Positioning for value capture, a measure of value chain strength of the company; Invest.: Investment grade, an individual company's risk-return profile *vis a vis* the type of capital best suited for this company

Risk Rating Strategy

One of the challenges for pension funds and other long-term institutional investors to more broadly allocate capital to green growth is the lack of scalable investment vehicles with appropriate market liquidity. The Multi-Asset Renewal Fund – an innovation on value chain investing – was designed with scale and liquidity that fits investment strategies of pension funds and other long-term investors.

A risk-rating approach was identified for the MARF that fund managers would already be familiar with and could readily integrate into their existing risk management and actuarial processes. In addition, the selected metric needed to be applicable to all the underlying assets that comprise the Fund. This is a necessary constraint, partly because the fund is comprised of liquid and illiquid assets, and partly because of the fundamental differences in capital structure across the asset types.

> Due to the illiquid nature of **private debt** and **private equity**, we developed an approach that involves the use of financial data for comparable public companies that are used as proxies for the private companies in both asset classes. By applying the 'comparables methodology', it was possible to apply the Capital Asset Pricing Model (CAPM) to estimate returns and volatility for the private company as if it were a public company. Naturally, we needed to incorporate liquidity discounts – as will be detailed later.

[4] Adriaens, P. and A.-J. Tahvanainen. 2016. Financial Technology for Industrial Renewal. ETLA Press, Helsinki, Finland

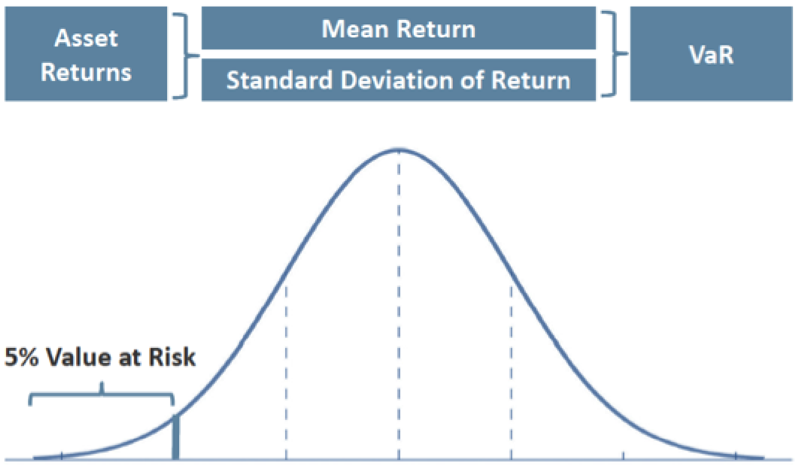
In the case of **SME debt**, the probability of default for each company is calculated, a liquidity premium due to the private nature and size of the debt is added, and the probability of default is compared with public bonds in the European market. For **public equities** we use the actual returns from a specified Smart Mobility Index of companies to calculate standard deviation and volatility. **Climate bond** analysis is conducted on qualifying bonds in the global marketplace, by calculating the one-month historical yield to worst and applied an equal weight.

A Monte Carlo analysis of these input data allows us to calculate a volatility risk for the MARF portfolio, using historical returns by exploring the correlation between the asset classes, and the individual assets in each asset class.

Integrating the risk of illiquid asset classes with those of the public equities
We were not able to use broadly deployed models such as the Barra Equity Risk Model and the Northfield Factor Model because of their focus on public equities (including ETFs), listed bonds and infrastructure or real estate companies, as well as funds based on these asset classes and sub-classes. In the case of the MARF - there are two asset classes that are not liquid or not traded daily on the market. The implication is that we generally do not know what their volatility is relative to market behavior, and whether these assets are correlated at all.

Therefore, we selected the Value at Risk framework (VaR) to assess the risk of the fund because of its ubiquitous use within the financial services industry, its flexibility to capture the nuances of each asset type, and its ability to integrate all asset classes into a single rating for the whole Fund. Further, it is a very intuitive metric to understand. Simply stated, VaR is the expected loss that will occur with a chosen probability of loss (e.g. 5%, 0.5%). The fundamental inputs to the VaR analysis are historical returns and expected returns. VaR was initially developed by banks to gain a quantitative understanding of their (short term) risk exposures, or extreme losses.

Figure 2. Integration of Value-at-Risk in MARF Risk Assessment. Source: Adriaens, P. and A.-J. Tahvanainen. 2016. [5]



It should be noted that with simplicity comes risk of overreliance on the metric. Indeed, the embedded risk associated with VaR estimates is that they are based on past data, i.e., they use the historical distribution of outcomes of the investment. Hence, relying solely on historical data can therefore give an inadequate risk measure. We considered this risk for the MARF (a long-term investment instrument with market liquidity), as we took in account a 10-

5 Adriaens, P. and A.-J. Tahvanainen. 2016. Financial Technology for Industrial Renewal. ETLA Press, Helsinki, Finland

year time series of data (except for climate bonds) in our estimates.

Risk Rating Estimates

It would take too long of a discussion to go through the actual risk rating estimates in each of the asset class segments, and we refer the reader to Chapter 7 in our treatise on "*Financial Technology for Industrial Renewal*" (Adriaens and Tahvanainen, ETLA Press, 2016). Liquidity risks, market risks, country risks (e.g. Finland), capital risk and funding risk were all taken into account.

a. Net asset value (NAV) time series modeling and cash flow volatility modeling approaches were used for private equity
b. Probability of loan default analysis was used for leveraged debt using a five-factor financial ratio model [Profitability (EBITDA-to-Total Assets), Leverage (Short-Term Debt-to-Equity Book Value), Liquidity (Cash-to-Total Assets), and Activity (EBITDA-to-Interest Expenses; retained earnings-to-Assets)].
c. An equally-weighted yield to worst (YTW) model was used for climate bonds. There are two primary obstacles in calculating the return and variance of climate bonds: Limited quantity of qualified climate bonds – due to the limited existence of the asset class, our analysis was restricted to 16 climate bonds currently in the marketplace; and limited history of return performance **–** due to the short history of the asset class, the available amount of historical performance data was minimal.
d. CAPM models were used to estimate risks and returns for the stocks in the Fund, adjusted for beta, country- and equity risk premium

Overall Performance (risk:return) of the Smart Mobility MARF

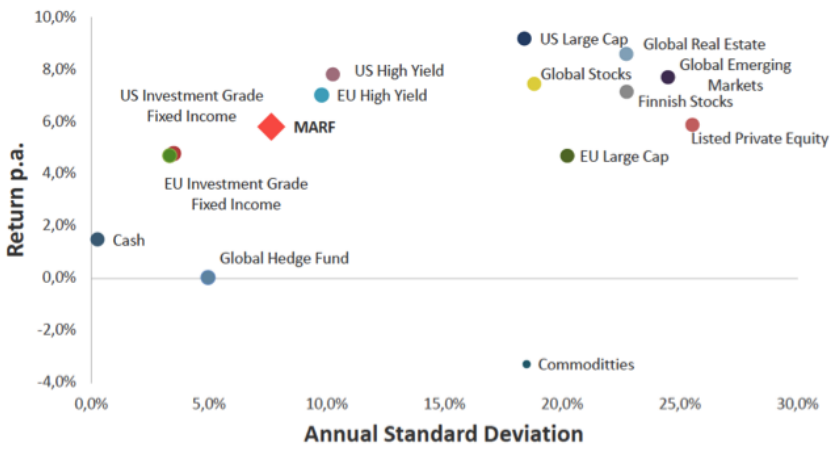
Calculation of the VaR for the entire fund first involves assembling the underlying assets into a portfolio resembling the MARF, calculating the VaR for each asset class, applying a Monte Carlo simulation to model the probability of different outcomes due to the intervention of random variables, and predicting the portfolio VaR for the MARF. Within the Monte Carlo analysis, the covariance between asset returns was used to calculate expected ***absolute returns*** for the portfolio.

To allow us to do this we chose a specific MARF design (Smart Mobility), allocations between the asset classes (PE, debt, ETF, and climate bonds), and allocations of the underlying assets in each asset class. It was important to consider how the risk rating would be used in the context of the MARF, ***a closed-end long-term investment fund, with a one-year lock in period***. Over a long investment horizon, severe losses will eventually be recovered if the fund is able to avoid large withdrawals of funds and sales of its assets. Thus, we were most concerned with fund losses over a shorter time horizon.

Returns and risks (VaR) were calculated for a $500 million smart mobility MARF, based on the companies selected in the Finnish pilot program (see chapter 4.1) and assuming the following initial target distribution over the asset class segments: private equity (10%), SME debt (35%), public equities (15%) and climate bond (40%). These are absolute returns based on the actual underlying assets.

To provide context for the performance of the MARF, annualized 2016 performance data (accessed April 22, 2016) were obtained from Bloomberg, a data aggregation platform, and Morningstar, an investment research and ratings company. Cash represents interest rate on money-markets accounts, whereas other investment options were selected to represent the range of returns and risk (volatility, measured as annual standard deviation). The data are snapshots in time, and need to be updated depending on the time horizon under consideration.

Figure 3. Risk-return profile (top) and VaR (bottom) of the Finnish Smart Mobility MARF relative to other investments. Source: Source: Adriaens, P. and A.-J. Tahvanainen. 2016. [6]



Since the underlying assets are sourced from uncorrelated industries (e.g. telecommunications and home electronics), and the MARF construct really manifests itself in the diversification and lack of correlation across asset classes, MARFs exhibit a VaR that is similar to high yield corporate bonds. Yet, the returns are similar to listed private equity. A comparable benchmark for the Fund is based on an index with 75% equities and 25% bonds.

The risk and return profile fits the investment mandate and fiduciary requirements for long-term investors, and the process is structured and semi-automated to help build the trust and familiarity of financial managers with this fund. Whether the trustees of pension or insurance funds, and managers of sovereign wealth funds, will consider including MARFs in their investment portfolios depends on the engagement of policy makers in the replumbing of the financial markets, and of experienced fund managers across the asset classes comprising the fund.

Hence, the optimization of MARF allocation strategies results in enhanced financial performance while accruing economic development benefits.

2. MARF and Energy Strategy 2050

What is the link between MARF programs and the Energy Strategy 2050? Could MARF programs eventually support and accelerate the realization and implementation of the Energy Strategy 2050? What could be the impact of most recent developments in the Fintech and Green Digital Finance space for both MARF programs and the Energy Strategy 2050? Although such questions can not be answered yet in full detail and require more in-depth research and analysis some first assessments suggest a rather intriguing potential.

Switzerland is a global financial powerhouse but also challenged by disruptions in the financial market sectors across the world, and needs to come up with new strategies and frameworks for the Swiss financial market place. The significant developments in the Fintech and Green Digital Finance space are offering timely advantages and benefits for the development of MARF programs.

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[6] Adriaens, P. and A.-J. Tahvanainen. 2016. Financial Technology for Industrial Renewal. ETLA Press, Helsinki, Finland.

At the same time, Switzerland is in the midst of a political and economical discussion about the future of its energy strategy and infrastructure. This unique situation provides daunting challenges and dazzling opportunities with a truly historic dimension. In a simplified approach, the strategic positioning potential for Switzerland's economy and society at the intersection of Fintech and Cleantech can be described with three key findings (see also chapter 5.2.2).

1. Switzerland is one of the world's leading finance hubs with highly sophisticated finance knowhow. Nevertheless, the mega-trends digitalization and decentralization lead to significant innovation pressure for traditional multi-national corporates, SMEs as well as young Startups. Within increasingly short timespans new strategic growth markets and unique selling propositions need to be identified and developed. The following examples showcase the dimension of the massive transformation that the industry is facing:
    - in September 2015 the regional initiative DigitalZurich2025 was launched. Just one year later - in September 2016 - the so far regional vision was expanded to a national vision with the transformation into DigitalSwitzerland.
    - in November 2016 the Federal Council decided to reduce the barriers to market entry for innovative financial technologies, e.g. with the creation of a FinTech License: For institutions carrying out only the deposit-taking business (acceptance of public funds), less stringent regulatory requirements should apply than those for classical banks.
    - at the WEF Davos - in January 2017 - Swiss Counsilor Doris Leuthard supported the launch of the global Green Digital Finance Alliance, initiated also by Jack Ma, founder of Alibaba and Ant Finance in China.
    - after years of intense political discussions about the new use and focus of the innovation park in the former military airport in Duebendorf it seems that the Blockchain topic could become a major driver and the core of a project called TrustSquare with the vision to become the world's new hub for research and business related to the internet of trust. Such a bold approach might put Switzerland again at the top of the global Fintech, Blockchain and Green Digital Finance map.

2. In the coming decades, Switzerland needs to invest Billions from private and institutional investors into the modernization and decentralization of the Swiss energy infrastructure (production, storage, distribution). These investments would lead to a strong home market for sustainable entrepreneurs and investors in Switzerland.

3. The demographic development with an increasingly aging Swiss population combined with instable global financial markets, ongoing massive quantitative easing programs by Central Banks, and low or even negative interest rates lead to a historic innovation pressure for institutional investors, e.g. pension funds. They are looking for future-proof resilient business models, services and investment alternatives.

    - Example: In February 2017 the Swiss pension fund NEST announced its new partnership with the company investiere.ch based in Zurich, and will allocate funds for direct investments in startup companies. NEST is the first Swiss pension fund realizing investments in startups in a systemic, strategic manner. Only some years ago such a partnership would have been simply unimaginable.

These three key findings provide a valuable framework for the MARF and Energy Strategy 2050 discussion and are a clear invitation to approach and explore potential synergies in a pro-active, strategic manner.

3. Differentiation of MARF Funds

Multi-Asset Renewal funds are designed to allow large capital placements in emerging thematic industry sectors, by combining financial and real asset class segments under one fund structure.

1. The real asset class segment represents both illiquid and cash-flow generating investments (venture capital, private equity, project finance, real estate) in assets focused on conservation, reclamation, industrial renewal, and sustainable infrastructure.
2. The financial asset class consists of globally diversified assets (stocks and bonds) relevant to the thematic industry clusters that drive economic activity in the region.
3. A managed futures (derivatives) structure is layered on the real asset class segment to track the cash flow and future value of the real assets, *and* to protect the investor from excessive direct exposure risks to an illiquid investment

The MARF differentiation can be described as follows: In the realm of sustainability finance, there are currently a range of options available to the investor: Green use-of-proceeds bonds that invest in projects with a sustainable mandate, ESG (Environmental, Social & Governance)-rated stocks, impact investment (mainly stocks and project finance) and conservation (primarily environmental returns; debt and grant instruments) funds, and venture capital/private equity (VC/PE) funds that invest in young companies and projects.

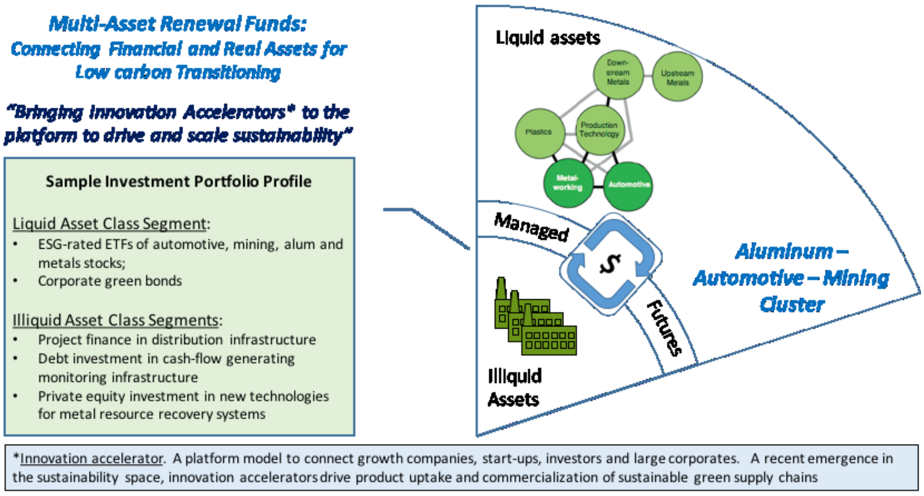
Many of these funds and financing vehicles have an environmental mandate and a thematic (e.g. energy, water, cleantech). However, none are structured around an emerging economic sector, or take into account the explicit relationships between corporate, SME and startup enterprises. The value of our funds is based on the premise that emerging low carbon industries leverage assets from multiple industry sectors. Cleantech has gone mainstream and is integrated across sectors, from healthcare to communications, from the chemical industry to manufacturing. It is no longer ‘a thing’, but ‘a new way of doing things’. Fund designs have to evolve to capture value in this new industry alignment.

MARF selection and design

Our process differs significantly from these funds in a number of ways (see example structure in Fig. 4):

1. The companies and projects selected for inclusion in the fund are based on financial network maps of transactions in an emerging industry ecosystem. Using data from public databases (e.g. Bloomberg and Factset, and private databases (e.g. CBInsights and the CleanTech Group), ‘industry networks’ are created that capture economic activity in an industry cluster.
2. The assets to be included in the fund are further filtered using unstructured (non-financial) data to indicate emergent growth opportunities in the thematic area under consideration. These include market, industry, and management risk metrics.
3. A rule-based system is deployed to integrate the unstructured metrics with financial metrics (efficiency, profitability, liquidity) to assign the investment grade of the company or bond, and allocate the asset to each investment asset class segment.
4. Asset allocation is further optimized using capital asset pricing models (CAPM) and portfolio allocation models to achieve at least 15% allocation of capital to real assets.

Figure 4. MARF sample structure



4. Results

4.1 Best Practice Benchmark: Emerging Cross-Sectoral Industry Eco-Systems in Finland

To provide an existing illustration of an emerging, cross-sectoral industry ecosystem, let us begin with mapping and assessing the Finnish Smart Grid space.[7] We then show the results for the Swiss case study.

Smart Grid as a concept is not a recent one, by any means. Demand-side management of electricity was among the earliest applications of a limited ‘Smart Grid’. The grid has gradually become “smarter” as IT-enabled technology has been integrated into the legacy infrastructure of energy production, transmission, distribution and consumption.

The proliferation of functionalities is reflected in many of the complementary definitions put forth by the various actors in the Smart Grid ecosystem: According to the International Electrotechnical Commission (IEC), a Smart Grid “is an electricity network that can intelligently integrate the actions of all users connected to it – generators, consumers and those that do both – to efficiently deliver sustainable, economic and secure electricity supplies. A Smart Grid employs innovative products and services together with intelligent monitoring, control, communication, and self-healing technologies to: (i) facilitate the connection and operation of generators of all sizes and technologies; (ii) allow consumers to play a part in optimizing the operation of the system; (iii) provide consumers with greater information and choice of supply; (iv) significantly reduce the environmental impact of the whole electricity supply system; and (v) deliver enhanced levels of reliability and security of supply.” The European Commission8 adds that: “Smart Grids are energy networks that can automatically monitor energy flows and adjust to changes in energy supply and demand accordingly. When coupled with smart metering systems, Smart Grids reach consumers and suppliers by providing information on real-time consumption. With smart meters, consumers can adapt – in time and volume - their energy usage to different energy prices throughout the day, saving money on their energy bills by consuming more energy in lower price periods. Smart Grids can also help to better integrate renewable energy […].”

Compared to the legacy paradigm, Smart Grids offer multiple benefits to their various con-

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[7] Financial Technology for Industrial Renewal. Adriaens, Peter and Tahvanainen, Antti. ETLA Press, 2016

[8] ec.europa.eu/energy/en/topics/markets-and-consumers/smart-grids-and-meters (last access Oct 12, 2015).

stituents, some of which are listed by the USDE. These include “more efficient transmission of electricity; quicker restoration of electricity after power disturbances; reduced operations and management costs for utilities, and ultimately lower power costs for consumers; reduced peak demand, which will also help lower electricity rates; increased integration of large-scale renewable energy systems; better integration of customer-owner power generation systems, including renewable energy systems; [and] improved security.” To summarize, Smart Grids create added value in the form of enhanced cost efficiency, greatly improved reliability and unprecedented production flexibility. Because the related benefits are appropriated by both producers and consumers, the emergence of Smart Grids is driven by forces of both demand pull and supply push.

Smart Grids are cross-industrial ecosystems

The definitions strongly imply that Smart Grids transcend the traditional boundaries of the energy production and transmission value chain. Monitoring, bi-directional data flows, machine-to-machine communication and electronics that enable automated optimization on system level are not in the capability domain of traditional utilities and transmission grid operators. Smart Grids necessitate the integration of a large number of other functional layers that build on top of the incumbent infrastructure of utilities and traditional grid operators. These include the communication infrastructure across which data is transmitted between the different stakeholders to the system; the meter data management layer; the demand response layer which exploits multi-source data to provide services for the optimized co-ordination of energy production and demand; the grid optimization layer which translates the data-based demand-response predictions into physical control of the system infrastructure; and the storage layer, which acts as a necessary buffer between peaks and troughs introduced by both volatile demand and renewable-based production of energy.

A closer look at the respective companies in the various layers of the Smart Grid ecosystem demonstrates that the structure of the system is highly cross-industrial. Indeed, it involves industry sectors and segments ranging from energy to telecommunications and software development; from machinery to industrial electronics and data analytics; and from computer hardware to home electronics and infrastructure construction. But how do these companies financially interact to form the ecosystem? What does the industrial skeleton – the value network – of the ecosystem look like?

Data, software and IT are the beating heart of the Smart Grid ecosystem

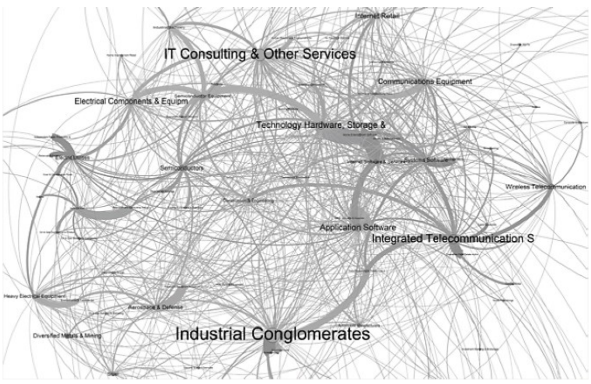

Figure 5. Smart Grid Ecosystem.

Subjecting the ecosystem to the financial network mapping analysis reveals the monetary flows between the involved industries and subindustries, and shows the intricate industrial structure of the entire system (Fig. 5). It is important to note that the input data employed were selected at the very detailed six-digit GICS (Global Industry Classification System) level, well below the broad industry sectors. Further details are described in Adriaens, P. and A.-J. Tahvanainen, 2016. [9]

Hence, the network map reflects an integration of value chain data in the context of sub-

[9] Adriaens, P. and A.-J. Tahvanainen. 2016. Financial Technology for Industrial Renewal. ETLA Press, Helsinki, Finland.

sector groupings of industries with similar business activities. However, even if business activities are similar, their respective business models may diverge significantly.

The edge thickness of connections between individual industry sectors denotes the relative financial exposure – i.e. the relative flows of money – between them. The thicker the edge, the more significant is the financial exposure – or trade relationship – between the industries.

Another key dimension in the map is the positioning of the industries relative to each other. Those positioned closer to the core of the map display a higher connectivity – or network centrality – to all other industries than those located in the periphery of the map. The higher the centrality, the more "important" the respective industry is to the mutual connectivity of the entire ecosystem. Industries of high centrality bridge the chasms between sectors that otherwise would have very low connectivity in a given ecosystem. Aside from social networks[10], this observation has been made in financial networks as well.

The centrality of nodes can be used to distinguish between the roles single industries have in the financial network structure of the Smart Grid ecosystem. Industries of high centrality are designated catalysts. They are built on the infrastructure of anchor industries that stake the perimeter of the ecosystem. Anchors are less well connected to the emerging ecosystem as they are still relatively contained in their incumbent industrial value chains. However, they serve an extremely important role as the providers of capital-intensive infrastructure and vital technological components. Good examples of essential Smart Grid infrastructure are energy production facilities and transmission grids maintained by utilities and grid companies as well as the telecommunication networks maintained by both integrated and wireless telecommunication operators. Technological components, in turn, are provided by electrical component and equipment manufacturers, industrial conglomerates, such as Siemens, Bosch and others, and communications equipment producers.

The role of catalyst industries, in turn, is the integration of the aforementioned industries to harness them for creating entirely new type of value that will be offered to users in the form of novel products and services. In the case of Smart Grid, this means increased efficiency, reliability and security through real-time, data-driven optimization technologies and services. One could argue that, in the case of Smart Grids, it is the catalyst industries that make the system intelligent – an Internet of Things (IoT). Catalyst industries include many software-based sectors such as systems software, application software and data processing. Semiconductors as well as technology hardware and storage further corroborate the centrality of IT-related solutions in tying together the intricate web of industrial activity in the Smart Grid ecosystem.

Smart Grid ecosystems display true industrial momentum

An economically viable Smart Grid financial network is a reality. Power utilities, electrical and mechanical component and systems manufacturers, information and communication technology producers as well as telecommunications operators form a strong infrastructure layer that provides the physical foundation for the entire Smart Grid ecosystem. This foundation integrates power generation technology, transmission and distribution grids, the respective electronic and mechanical equipment as well as telecommunication grids and their control technology. On top of the foundation, data and software-driven companies build scalable, fast growing businesses, leaning on the resources of the entire infrastructure layer. In doing so, cross-industrial value chains emerge and enable the creation of service models that add new value in the form of improved efficiency, reliability and flexibility. It is these companies that connect the involved legacy industries to form the emerging ecosystem and to make it "smart". IT-hardware developers, data storage companies, application and systems software

10 Soramäki, K. & Cook, S. (2016). Network Theory and Financial Risk.

developers, as well as data processing and analytics companies are in this growing nexus of the Smart Grid ecosystem.

Machine-to-machine communication -enabled grid and facility automation, remotely controlled smart homes and factories, micro-grid integration, demand response optimization, and predictive grid maintenance services are just few examples of new value added products and services powered by IT- and software-driven solutions. The multilateral structure allows for abundant roundput, distributing factors of production in the form of raw materials, components, systems, products and services across single industry boundaries.

As the differences in edge thickness reveal, financial roundput is more intense among catalyst industries in the ecosystem, indicating a higher intensity in either activity, volume or both. This corroborates the importance of catalyst industries that seem to constitute the active core of the ecosystem. We all well know the structures of incumbent energy markets that have been exposed to changes via agile, digital service businesses to add intelligence to the legacy infrastructure. In fact, financial network maps are just the tool for uncovering gradual changes in the environment, especially when applied across time in a series of analyses.

Telecommunication industries are better positioned to hop on the smart wagon

As an interesting final remark on the ecosystem's structure, the catalyst sectors seem to be more closely affiliated with telecommunications-related sectors than with energy utilities or component manufacturers. The close relationship is a tangible legacy of the internet era that witnessed the convergence of telecommunications providers, software developers, and data analytics services to create the still quickly evolving internet ecosystem. These relatively close ties will put telecommunications providers in a more advantageous position to capture value in the Smart Grid space as they already form an important part of the respective ecosystem structure.

One of their most valuable asset is an existing, proliferated and captive customer and payment interface that reaches every single individual with a phone or internet connection. Telecommunications companies such as Nokia and Cisco have indeed engaged in strategic investments or acquisitions of home, local area, and geographic network and security companies to enable the roll out of new smart, digital services through their interface.

Value capture assessment of Finnish Smart Grid companies reveals true strengths and uncovers challenges

The analysis rests on the fundamental assumption that a company's capability to capture most of the value it generates depends on the degree of control it asserts over relevant core assets vis-à-vis other stakeholders in the ecosystem. The less dependent a company is on specialized assets controlled by 3rd parties, the better is its capability to capture value from the ecosystem. It is important to note that the results are specific to the industry ecosystem where the company intends to compete. Pursuing multiple lines of business, more mature companies tend to operate in different ecosystems simultaneously. Overall, Finnish Smart Grid companies hold fairly strong positions in the ecosystem. As the distribution across the four quadrants shows, a very decent share of the 96 companies display either high-growth business potential or compete via beneficial partnering and licensing strategies. Differences between company types as defined by size are hard to discern, i.e. neither of the two company types consistently outperforms the other based on the KeyStone metrics. Large enterprises may have a predominance in the partnership segment, common to companies with complex supply chains and cross-border business activities.

The four drivers that determine a company's value capture potential – dependency on third parties, leveragability of 3rd party assets, replicability of the company's capabilities and the connectivity of the company to the relevant ecosystem – do not show statistically significant differences between startups, SMEs and large enterprises. That being said, the figure does provide insights as to which of the four drivers specifically contribute to the fairly strong positioning of Finnish Smart Grid companies. Two of them stand out in particular: The first is a generally low dependency on third party assets. This implies that the companies exercise control over the relevant core assets – both tangible assets in the form of production facilities, information systems and infrastructure as well as intangible assets such as human capital, trademarks, and patents – needed to create their offering. The companies tend to be either highly integrated or serve as system integrators to generic component suppliers, in which case they have a broad enough choice of partners to avoid lock-in. In parallel, the dependency on strong partners for market access is similarly low, which helps to appropriate a larger share of value from end-user markets. The decent overall connectivity to the ecosystem, a separate driver of value capture in itself, further promotes the companies' freedom to operate in the emerging industry space. The second driver is the difficulty of competitors and partners to replicate the companies' capabilities in generating value. The positive results with regard to replicability speak of both strong intellectual property protection strategies as well as the presence of experienced and capable management teams that can leverage their accrued skills in navigating the emerging business ecosystem. This human capital is tacit in nature and therefore hard to copy or imitate.

Leveragability is the unfortunate chink in the armor of the four drivers - leveragability clearly is the weak spot of Finnish Smart Grid companies. While dependency measures the strength of influence that external parties exercise over a company, leveragability measures a company's ability to exploit its assets and partners to its own advantage. This includes the tangibility of core partnerships via contracts, joint ventures and other agreements but also the fierceness of the competitive environment and the degree of concentration in the industry, i.e. the market structure. Tough competition, an oligopolistic market structure and frail partnerships all gnaw at overall leveragability of company assets. While the relatively weak leveragability does not seem to critically affect overall value capture potential, it has major indirect impact on the investment grade of the companies, as will be shown shortly. In particular, it has a strong inhibiting effect on the value that companies can normally reap from the diversification of their capabilities and markets.

Low expected profitability and the mediating effect of low leveragability negatively impact the firms' upside potential. These results for investment grade provide for striking insights. Across the board, irrespective of company type, the upside potential seems to be limited. Very few startups and SMEs show traditional equity investment grade. The great majority of companies finds itself in the lower two quadrants of the Keystone Compact® investment grade matrix. Two main drivers can be identified for the phenomenon. The first driver is a relatively low expected profitability of companies. The expected profitability of companies depends on a variety factors. These include the competitive structure of the targeted markets, their respective growth rates, the degree of commoditization of the companies' offering, expected margins typical for the targeted industry, the degree of separation from the end customer, the degree of recurrence in the revenue model and, finally, the degree of control over the sales channels. Given these factors, what can companies do to improve their prospective profitability? Many of the listed factors relate to the competitive structures, growth rates and average profitability of the respective markets. These are factors that are in part external to the company and its sphere of influence. They represent market-driven systemic risks. There are two options that any company has when faced with unfavorable market conditions.

The first is to seek out new markets with more favorable conditions for leverage and value capture. However, pivoting to new, less competitive and less concentrated markets with higher average profitability is a daunting task for any organization with a relatively fixed set of often market-specific skills and networks. To use a somewhat loose allegory for support, it is difficult for a lawyer to become a medical doctor because the required assets and skills are quite different and hard to adopt in a strategic move. Hence, companies will attempt to ‘platformize’ (see insert) their offerings to attract broader applicability and easier pivoting to new markets, even if this requires setting up new partnerships to access those markets. The second option is to adapt business models. This could encompass (a) new value chain strategies that emphasize gaining control over and shortening the relevant channels to the targeted markets, and (b) re-designed business models with a focus on creating multiple and recurring revenue streams. Amongst many options, new value chain strategies can take advantage of the progress made in digitalized technologies, for instance, that help to move from physical distribution networks to generic online distribution platforms. These inherently have global reach and are not based on exclusive and captive distribution contracts. As for new business models, moving from classic make-and-sell models to anything-as-a-service (XaaS) models – a manifestation of servitization – has been somewhat of a trend, which provides for recurrent sales revenues in conventional and emerging industries alike. A XaaS -approach brings particular benefits to manufacturing-driven businesses – such as component or subsystem manufacturers – that produce long-lived capital goods. In these businesses, re-sale cycles are long and, therefore, sales occur sporadically. A component-as-a-service model would provide for valuable customer lock-in effects and generate steady revenue streams, as well as benefit the capital efficiency of the operations. For the customers, on the other hand, the benefit is in not having to make expensive investments into capital goods that will pose a capital risk to the liquidity of the business and have a major detrimental impact on key financial metrics such as Return on Capital Employed (ROCE). The second driver behind the marginal upside potential is the previously discussed inhibiting effect that the seemingly low leveragability of the companies has on the benefits they could reap from their otherwise high degree of market diversification. Besides measuring the maturity of the industry – here Smart Grid – and the control that large enterprises have over it, the diversification metric indicates whether companies have identified opportunities to exploit their offering and capabilities on alternative, adjacent markets. These could serve as additional growth opportunities either by re-positioning the entire business or through additional lines of business. As asserted by the results, the companies in the Finnish Smart Grid industry fare reasonably well in this dimension. However, their weak ability to leverage proprietary asset strength against other stakeholders – such as suppliers, customers, and competitors – in their industry ecosystem significantly hamper their opportunity to take advantage of valuable market diversification strategies. Leverage is the benevolent twin of malevolent dependency. Companies should avoid strong dependencies on partners to avoid being marginalized or commoditized, but a weak ability to leverage their strengths for growth is equally detrimental to business. Often, this is the result from competition on price, rather than on value.

Large enterprises exhibit a very cautious approach to enter the Smart Grid space. A final, yet very telling, insight is that large enterprises fare particularly poorly in terms of how they view the Smart Grid opportunity. With few exceptions, the cluster of large enterprises with LOB’s positioned for Smart Grid locates mostly in the lower left quadrant of the Keystone Compact™ investment grade matrix. Hence, the Smart Grid opportunity is viewed as being either short-term ‘opportunistic’ or longer-term ‘competitive’. In the case of eight companies, the Smart Grid market is viewed as being ‘strategic’ or ‘expansional’.

As a brief review, the upper-right quadrant represents high-potential opportunities that enterprises can turn into value relatively quickly, using strategic acquisitions to acquire new market share, in-licensing and other expansional strategies. The upper-left quadrant represents high-potential opportunities that can be captured via long-term projects and strategic acquisitions to acquire new skills or technologies. The lower right quadrant is the space of opportunities that will be pursued for more opportunistic reasons: the overall value of the opportunity may not be particularly high, but it is quick to exploit and will not require large investments, and are often internal ones. Finally, the lower left quadrant, the space in which most Finnish Smart Grid enterprises are positioned, defines prospects that do not show particularly high upside potential nor are quick to be exploited; the opportunities represent wait-and-see hedging opportunities and not explored for direct significant financial gain. The obvious question is, why are Finnish large enterprises with activities in the Smart Grid space overly conservative? Is the reason capital resource conservation? Or risk aversion in an uncertain market environment? Perhaps they are cautious to sound out a new opportunity space, the economic prospects of which still remain somewhat vague? The companies' LOBs score extremely weakly in both scalability and capital efficiency when benchmarked against their smaller counterparts. Average capital efficiency, in particular, is extraordinarily low. These two drivers determine the speed at which any given opportunity can be exploited and scaled, and push the majority of enterprises into the lower left quadrant. To extract insights from the findings, we need to break down the drivers in more detail. A low scalability score is indicative of a business model with long sales cycles and limited opportunity for value capture through diverse revenue models. In addition, the degree of synergy of the pursued business with the enterprise's other lines of business, the degree of commoditization of its products and services, the length of the typical sales cycle from sales lead to conversion, the ease of integrating the product or service into the customers' processes, the dependency on external sales channels, the maturity and concentration of the target market as well as the degree of regulation in the target market affect scalability. Low capital efficiency, in turn, is driven by high investment requirements in physical assets for growing revenue streams, a focus on the production of physical products, low economies of scale in the production, and a low asset turnover rate typical for companies operating in the targeted industry segment. In light of the findings we can then argue that Finnish enterprises are seemingly intent on entering the Smart Grid space with a choice of conventional strategies, relying on practices and models they know best from their legacy businesses: manufacturing-centric, capital intensive business models combined with slow-cycling sales models that are well suited for mature capital good markets, but are too sluggish and inflexible for capturing value in the fast growing, data- and analytics-driven smart layers of the emerging Smart Grid ecosystem. Our earlier work shows that manufacturing businesses are the clear center of gravity in the Finnish Cleantech space, even more so than in the domestic industry in general. In the gold rush era of digitalization, a heavily manufacturing- and engineering focused company base can quickly become the ball-and-chain to the mid-to-long-term growth of the industry. Hanging on to the legacy comes with the risk of being pushed to the proverbial periphery of the growing Smart Grid ecosystem. The ecosystem map in the previous chapter provides tangible evidence of this trend: Telcos as well as software and data analytics companies currently fight for dominance over the demand-response space, an area in which power utilities could reign superior given their control over the most central of physical assets, namely the power generation and transmission infrastructure. The findings provide for valuable insights that investors, company executives and economic developers can use to design a strategic roadmap for the Finnish Smart Grid sector.

4.2 Best Practice Benchmark: Blue Growth Fund in the Great Lakes Region, US

In the Great Lakes Region, insights and learnings from Mult-Asset Renewal Fund/MARF programs are for the first time leveraged in a cross-border situation and with defined core environmental impact metrics. The Great Lakes region of North America is a bi-national Canadian-American region that includes portions of the eight U.S. states of Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania and Wisconsin as well as the two Canadian provinces of Ontario and Quebec. The region borders the Great Lakes and forms a distinctive historical, economic, and cultural identity. The Great Lakes contain a full fifth of the world's surface fresh water supplies. The Great Lakes region is home to more than 105 million people and the World's 3rd largest economy at a GDP/Gross domestic product of USD 5.6 trillion. This equals roughly 28% of combined U.S. and Canadian economic activity.[11]

The Great Lakes-St. Lawrence Blue Growth Fund (short: The Blue Growth Fund) is a diversified liquid alternative impact investment strategy under development since 2016 to maintain the Basin's natural resources. Goal of the Blue Growth Fund (USD 500 million) is to attract mainstream capital in a multi-asset portfolio, driven by real assets and private equity impact investing. It aims to build and grow long-term support for the Basin's protection, preservation,

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[11] Council of the Great Lakes Region Economic Forum 2017

and continued sustainable wealth generation. The Blue Growth Fund has defined core environmental impact metrics:

- 20% reduction of nutrient inputs in the Great Lakes
- 10% increase in energy efficiency for water utilities
- 10-15% reduction in carbon emissions resulting from less energy use and sustainable forest and nutrient management.

The Blue Growth Fund will select investments for risk-adjusted performance from the underlying real economy and capital market components (e.g. bonds, insurance). The thematic focus selected for the fund is driven by key economic drivers in the region that are water-dependent, have the potential to impact water quality, quantity, emissions, and energy metrics, and can transform local and regional economies. These include smart utilities, agriculture and climate-smart forestry.

Motivation

For decades, the Great Lakes Region has been dependent on government funding for maintenance, and preserving long-term viability to support industrial & public activities. Given the wealth that has been created from the natural resource in a wide range of economic sectors, the Blue Growth Fund seeks to uncover growth opportunities to capture some of the wealth and sustain the Basin. The focus will be on smart water utilities, agricultural technology and forest management.

Fund design approach

The Fund design approach includes the following elements:

- A liquid alternative ('liquid alt') investment structure. Combination of regional real assets ('water beta') and liquid investments in three thematic industry sectors: smart water, agriculture and smart forest management.
- Industry cluster-based asset selection. The universe of companies and infrastructure/project deals are sourced based on financial network models that define industry clusters across thematic value chains.
- Impact Quality. ESG (Environmental, Social, Governance) metrics are integrated across all asset classes to preserve the intentionality of the Fund
- Diversification and correlation. Diverse asset class segments across industries industries and water alpha (excess returns for ESG value) ensure low market correlation.

Investment targets

Three investment thematic sectors are targeted within the Blue Growth Fund, based on their capacity to (a) affect the environmental core metrics aimed at sustaining the quality of the Great Lakes Basin, (b) their scalability for investments, and (c) the available deal flow in the real asset class: smart water, agriculture, and forest management. The Blue Growth Fund targets market rate returns for different asset sectors envisioned for the various thematic areas of investment.

Conclusions

Due to sensitivity reasons with regards to the development of the Blue Growth Fund only few information can be shared publicly at this time. However, the following conclusions can be helpful to develop similar programs:

- The Blue Growth Fund model is the first place-based investment strategy for water
- The emphasis will be on real asset and private equity impact investments
- Financial modeling mirrors environmental modeling to preserve the intentionality
- Pension funds, asset managers, credit rating and insurers are strategic partners of the Blue Growth Fund and inform the fund design process.

4.3 Switzerland's Comparative Strengths in Emerging Ecosystems

As demonstrated in the Finnish case, company-level ecosystem mapping and investability analyses provide powerful tools for the identification of national strengths and weaknesses in currently emerging business ecosystems. In smart ecosystems, incumbent sectors of the economy seem to run danger of being sidelined by agile, digital service companies unless they are able to pivot their conventional, capital-intensive business models. Finland is not doing a particularly great job at it, but this might be a more widespread phenomenon given the immature development stage of the smart grid ecosystem in general.

How is Switzerland faring, then? For the potential analysis of cluster ecosystems in Switzerland the focus was laid on two ecosystems, in particular, that are in the center of current policy initiatives in the country - Smart Grids and Smart Mobility. The analyses aimed to answer a very specific question: Given the global industrial structure of the two ecosystems, which sectors thereof does the Swiss economy wield a comparative advantage in?

Before proceeding to the results, it is important to understand why comparative advantage is such a central concept in measuring the prowess of economies in the midst of the on-going digital transformation. When asked about whether a country is in the race towards becoming a top contender in rising ecosystems such as smart grid or smart mobility, very few heads of state will answer no. Every developed nation on the planet is currently investing resources into capturing the potential presented by the digital transformation washing over virtually every single sector of the economy. A frequently encountered illusion is that a country can "do it all", i.e. push the technological and business frontiers of entire ecosystems. Truth is, today's ecosystems are global and every economy has its strong and weak points in certain subsectors relative to other contenders.

Comparative advantage advocates focusing the resources of any given economy on sectors it wields the strongest assets in relative to other sectors of the economy. However, for the purposes of the report at hand, it was not enough to determine which sectors of the Swiss economy have a more established asset base relative to each other; this limited approach would have been agnostic as to the strengths of Switzerland relative to the global asset base. Therefore, it was necessary to first construct the distribution of *global* assets by the sector and the ecosystem, and only then compare the Swiss company base relative to the established global distribution.

We first employed smart search filter capabilities built into Factset's (www.factset.com) proprietary database to establish the industrial structure by sectors for both examined ecosystems, Smart Grids and Smart Mobility. The smart search filters allow for a keyword-based, global identification of companies. This is a crucial function since you now know that emerging ecosystems are indifferent to conventional industry categorizations and industry classification systems. Keywords such as "demand-response", "smart grids", "grid automization", "energy storage", and "smart homes" allowed us to hunt down companies by their thematic activity.

Once the exhaustive global pool of companies in an ecosystem was identified, we isolated those companies that hold their headquarters in Switzerland into a separate pool. Now we had one pool containing all Swiss companies active in an ecosystem, and another containing the global pool of companies active elsewhere around the globe. We then aggregated the companies in each pool according to classic industry classification codes (North American Industry Classification System; NAICS) on the 6-digit level that categorizes companies according to their respective sub-sectors of the economy. We then calculated company frequencies for each of the identified NAICS sectors and determined each sector's relative share within its respective pool. In a last step, we compared the shares of sectors in the Swiss pool with those in the global pool to determine the relative comparative advantage of the Swiss economy in the two examined ecosystems.

The following sections discuss which sectors of the examined ecosystems the Swiss economy holds a comparative advantage in relative to the rest of the world.

4.3.1 The strengths and weaknesses of the Swiss economy in the Smart Grid ecosystem

Table 1 shows the results for the Swiss Smart Grid ecosystem. Switzerland wields a comparative advantage over the world in sectors highlighted in blue. Sectors highlighted in red, in turn, are underrepresented in the Swiss economy. A few key findings can be drawn immediately:

1) To start with, the share of purely trade related sectors is astounding. Almost every fifth company (19%) operates a wholesale business. Trade is mostly focused on electronics, computers and software, as well as electrical equipment. While these sectors are considered key to the structure of the Smart Grid ecosystem in a thematic sense, under no circumstances is the trade business to be even remotely compared with the respective industry or services sectors.

   The crucial difference between trade and industry is the amount of value added they generate in a country. While the industry and services create abundant value added in the form of employment, the use of other local factors of production, and profit, the majority of wholesale businesses trade mostly in imported goods, the value added of which is generated in the respective countries of origin. If anything, a strong presence of wholesale businesses in any given sector might signal a deficiency in the national industrial and services base in that specific sector; the lack of local production must be compensated for by importing the respective goods from foreign markets.

   In the present case, however, a look at the remaining list of sectors with a comparative advantage provide an alternative explanation: there is an evident and heavy emphasis on manufacturing-based sectors. It is quite possible that these manufacturing businesses are fed by the strong wholesale sector with parts and sub-components for the production of machinery, measuring and controlling devices, semiconductors, lighting equipment, electrical equipment, testing instruments, household appliances, transformers and other physical products that occupy the list of sectors the Swiss hold a comparative advantage in. These sectors specialize in high value added production, drawing on lower value added parts and components from abroad.

2) A focus on high-end manufacturing in Switzerland does not come as a surprise. The Swiss are world-famous for high-quality, precision machinery and equipment. In the present case, more than a fifth (21%) of Swiss companies captured in Table 1 operate a manufacturing-driven business. Swiss sectors of strength, in particular, feature many that are manufacturing-related.

   Manufacturing centricity in and by itself is not to be considered disconcerting. Manufacturing is still a labor-intensive mode of production that sustains employment and represents a formidable source of value added. Value added, in turn, is the most central metric of a country’s level of welfare.

   In the context of Smart Grids, however, the heavy reliance on manufacturing-related sectors is worrisome. As demonstrated in the Finnish benchmark, manufacturing-centric business models can very quickly become the ball and chain to the growth of the Swiss Smart Grid ecosystem. As the entire Cleantech space is dominated by a paradigm shift towards digitally driven, servitized business models such as the ones run by Uber and Airbnb, so is the growth of value added in the Smart Grid ecosystem driven by companies providing data analytics services, algorithmic demand prediction, infrastructure virtualization, smart home solutions, predictive maintenance services, etc.

As shown for the majority of Finnish anchor industries in the Smart Grid space, manufacturing-centric business models put the respective companies, even entire sectors, at risk of being marginalized to the periphery of the fast-growing ecosystem. Key to capturing value from the emerging Smart Grid ecosystem will depend on whether companies in the threatened sectors will be able to integrate down-stream by way of acquisitions of – or tightly partnering with – companies that are in the nexus of digitally growing value chains. High-end manufacturing businesses able to charge superior margins will weather the on-going change better than commodity businesses but even they will forfeit the exponential opportunities that smart solutions bring with them.

3) While manufacturing is the stronghold of the Swiss Smart Grid economy, the identified growth nexuses – software, data analytics, and digital platforms – are a weak spot. Computer systems design and internet publishing are the only two sectors listed among those with a comparative advantage vis-à-vis the world. Software publishers, data processing services, and custom programming are all to be found amongst Smart Grid-related sectors that are underrepresented in Switzerland.

As argued above, these data-driven sectors are the new growth centers of the newly emerging value chains and form the essential bridges between incumbent, still relatively isolated sectors such as power utilities, telecommunications, and component manufacturers. The lack of these catalyst sectors in Switzerland means that the country forgoes many of the societal benefits associated with growth sectors, including new job creation and economic growth beyond the effects that the renewal of the resident incumbent industry will bring with it.

Table 1, Reading example:

- The column #CH indicates the number of Swiss-registered firms active in the respective sector. These need not necessarily be Swiss-owned or -founded businesses.
- The column %CH, in turn, displays each industry sector 's share of the total population of Swiss-registered companies active in the entire ecosystem that the table describes.
- The column %WORLD indicates each industry sector 's share of the total WORLD population of companies active in the entire ecosystem around the globe. Of course, Swiss-registered firms have been excluded from the global population for comparison's sake.
- Finally, the column Diff. shows the sector-specific differences in company shares to highlight those sectors, in which Switzerland has a relative overrepresentation in companies as compared to the world population, and in which it is underrepresented.
- The sectors have been sorted in ascending order starting with those that attest to the strongest overrepresentation.

NAICS INDUSTRY	#CH	%CH	%WORLD	Diff.
Other Electronic Parts and Equip. Merchant Wholesalers	521	8.3 %	1.6 %	**6.7 %**
Electrical Apparatus and Equip., Wiring Supplies, and Related Equip. Wholesalers	382	6.1 %	2.2 %	**3.9 %**
Computer and Computer Peripheral Equip. and Software Merchant Wholesalers	261	4.2 %	1.6 %	**2.5 %**
All Other Industrial Machinery Manuf.	193	3.1 %	1.3 %	**1.7 %**
Other Electric Power Generation	265	4.2 %	2.8 %	**1.4 %**
Other Measuring and Controlling Device Manuf.	124	2.0 %	0.6 %	**1.4 %**
All Other Professional, Scientific, and Technical Services	159	2.5 %	1.2 %	**1.4 %**
Engineering Services	404	6.4 %	5.1 %	**1.3 %**
Semiconductor and Related Device Manuf.	184	2.9 %	1.6 %	**1.3 %**
Electric Power Distribution	169	2.7 %	1.5 %	**1.2 %**
Research and Development in the Physical, Engineering, and Life Sciences	146	2.3 %	1.4 %	**0.9 %**
All Other Miscellaneous General Purpose Machinery Manuf.	97	1.5 %	0.9 %	**0.6 %**
Computer Systems Design Services	218	3.5 %	3.1 %	**0.4 %**
Wired Telecommunications Carriers	147	2.3 %	2.0 %	**0.3 %**
Other Lighting Equip. Manuf.	37	0.6 %	0.4 %	**0.2 %**
All Other Miscellaneous Electrical Equip. and Component Manuf.	88	1.4 %	1.2 %	**0.2 %**
Instrument Manuf. for Measuring and Testing Electricity and Electrical Signals	79	1.3 %	1.1 %	**0.1 %**
Electric Housewares and Household Fan Manuf.	22	0.4 %	0.2 %	**0.1 %**
Internet Publishing and Broadcasting and Web Search Portals	171	2.7 %	2.6 %	**0.1 %**
Power, Distribution, and Specialty Transformer Manuf.	39	0.6 %	0.6 %	**0.1 %**
Totalizing Fluid Meter and Counting Device Manuf.	16	0.3 %	0.2 %	0.0 %
Heating Equip. (except Warm Air Furnaces) Manuf.	24	0.4 %	0.4 %	0.0 %
Power Boiler and Heat Exchanger Manuf.	23	0.4 %	0.4 %	0.0 %
Nuclear Electric Power Generation	3	0.0 %	0.1 %	0.0 %
Hydroelectric Power Generation	54	0.9 %	0.9 %	0.0 %
Instruments and Related Products Manuf. Controlling Industrial Process Variables	32	0.5 %	0.5 %	0.0 %
Metal Coating, Engraving, and Allied Services to Manufacturers	13	0.2 %	0.2 %	0.0 %
Laminated Plastics Plate, Sheet (except Packaging), and Shape Manuf.	6	0.1 %	0.1 %	0.0 %
Electric Bulk Power Transmission and Control	9	0.1 %	0.2 %	0.0 %
Pump and Pumping Equip. Manuf.	26	0.4 %	0.5 %	0.0 %
Semiconductor Machinery Manuf.	6	0.1 %	0.1 %	0.0 %
Other Communications Equip. Manuf.	42	0.7 %	0.7 %	0.0 %
Electronic Computer Manuf.	31	0.5 %	0.5 %	0.0 %
Fiber Optic Cable Manuf.	13	0.2 %	0.3 %	**-0.1 %**
Fluid Power Cylinder and Actuator Manuf.	2	0.0 %	0.1 %	**-0.1 %**
Primary Battery Manuf.	1	0.0 %	0.1 %	**-0.1 %**
Automatic Environmental Control Manuf.	6	0.1 %	0.2 %	**-0.1 %**
Mechanical Power Transmission Equip. Manuf.	5	0.1 %	0.2 %	**-0.1 %**
Landscape Architectural Services	12	0.2 %	0.3 %	**-0.1 %**
Printed Circuit Assembly (Electronic Assembly) Manuf.	7	0.1 %	0.2 %	**-0.1 %**
Nonferrous Metal (except Copper and Aluminum) Rolling, Drawing, and Extruding	2	0.0 %	0.1 %	**-0.1 %**
Satellite Telecommunications	9	0.1 %	0.3 %	**-0.1 %**
Process, Physical Distribution, and Logistics Consulting Services	69	1.1 %	1.2 %	**-0.1 %**
Human Resources Consulting Services	9	0.1 %	0.3 %	**-0.1 %**
Fossil Fuel Electric Power Generation	6	0.1 %	0.2 %	**-0.1 %**
Natural Gas Distribution	50	0.8 %	0.9 %	**-0.1 %**
Current-Carrying Wiring Device Manuf.	2	0.0 %	0.2 %	**-0.1 %**
Lessors of Nonfinancial Intangible Assets (except Copyrighted Works)	6	0.1 %	0.2 %	**-0.1 %**
Commercial, Industrial, and Institutional Electric Lighting Fixture Manuf.	2	0.0 %	0.2 %	**-0.1 %**
Electronic Coil, Transformer, and Other Inductor Manuf.	5	0.1 %	0.2 %	**-0.1 %**
Geophysical Surveying and Mapping Services	3	0.0 %	0.2 %	**-0.2 %**
Telephone Apparatus Manuf.	9	0.1 %	0.3 %	**-0.2 %**
Storage Battery Manuf.	12	0.2 %	0.4 %	**-0.2 %**
Other Computer Peripheral Equip. Manuf.	17	0.3 %	0.5 %	**-0.2 %**
Other Communication and Energy Wire Manuf.	20	0.3 %	0.6 %	**-0.2 %**
Copper Ore and Nickel Ore Mining	5	0.1 %	0.3 %	**-0.2 %**
All Other Basic Inorganic Chemical Manuf.	26	0.4 %	0.7 %	**-0.2 %**
Other Building Equip. Contractors	17	0.3 %	0.5 %	**-0.3 %**
Motor and Generator Manuf.	9	0.1 %	0.4 %	**-0.3 %**
Switchgear and Switchboard Apparatus Manuf.	7	0.1 %	0.4 %	**-0.3 %**
Automobile Manuf.	17	0.3 %	0.6 %	**-0.3 %**
Bare Printed Circuit Board Manuf.	11	0.2 %	0.5 %	**-0.3 %**
Power and Communication Line and Related Structures Construction	17	0.3 %	0.6 %	**-0.3 %**
Radio and Television Broadcasting and Wireless Comm. Equip. Manuf.	7	0.1 %	0.5 %	**-0.4 %**
Hardware Manuf.	5	0.1 %	0.4 %	**-0.4 %**
Architectural Services	57	0.9 %	1.3 %	**-0.4 %**
Environmental Consulting Services	3	0.0 %	0.4 %	**-0.4 %**
Wireless Telecommunications Carriers (except Satellite)	58	0.9 %	1.3 %	**-0.4 %**
All Other Information Services	26	0.4 %	0.8 %	**-0.4 %**
Custom Computer Programming Services	225	3.6 %	4.0 %	**-0.4 %**
Electrical Contractors and Other Wiring Installation Contractors	157	2.5 %	2.9 %	**-0.4 %**
Other Scientific and Technical Consulting Services	21	0.3 %	0.8 %	**-0.4 %**
Other Electronic Component Manuf.	79	1.3 %	1.7 %	**-0.5 %**
Security Systems Services (except Locksmiths)	28	0.4 %	0.9 %	**-0.5 %**
Data Processing, Hosting, and Related Services	90	1.4 %	1.9 %	**-0.5 %**
Residential Remodelers	15	0.2 %	0.8 %	**-0.6 %**
Plumbing, Heating, and Air-Conditioning Contractors	106	1.7 %	2.3 %	**-0.6 %**
Marketing Consulting Services	54	0.9 %	1.5 %	**-0.6 %**
Other Computer Related Services	82	1.3 %	2.0 %	**-0.7 %**
Industrial Building Construction	18	0.3 %	1.0 %	**-0.7 %**
Gold Ore Mining	17	0.3 %	1.1 %	**-0.8 %**
Oil and Gas Pipeline and Related Structures Construction	10	0.2 %	1.0 %	**-0.8 %**
Other Heavy and Civil Engineering Construction	41	0.7 %	1.9 %	**-1.2 %**
Software Publishers	304	4.8 %	6.3 %	**-1.5 %**
Administrative Management and General Mgmt. Consulting Services	69	1.1 %	2.6 %	**-1.5 %**
Software Reproducing	153	2.4 %	4.3 %	**-1.9 %**
All Other Telecommunications	201	3.2 %	5.2 %	**-2.0 %**
All Other Business Support Services	90	1.4 %	4.3 %	**-2.8 %**
TOTAL	**6283**			

Table 1. Distribution of companies in Smart Grid -related sectors (CH vs. World); see reading example

4.3.2 The strengths and weaknesses of the Swiss economy in the Smart Mobility ecosystem

Much in line with the evolution of Smart Grids, the emergence of the Smart Mobility ecosystem is driven by the various negative externalities that accompany the self-reinforcing, global megatrend of urbanization. The World Resources Institute (WRI) claims that 70 percent of energy-related greenhouse gas emissions are produced in cities, and that developing cities, in particular, would contribute to the majority of traffic crashes that claim 1.2 million lives per year. The WRI explains that congested traffic cost the cities of Rio de Janeiro and São Paulo a combined $43 billion in 2013. The equivalent figure for Beijing, including costs related to air pollution, the Institute estimates at 7–15 percent of GDP of the city. A study by the New Climate Economy, in turn, finds that Americans bear an extra cost of US$1 trillion related to urban sprawl.

To tackle these externalities, ICT-driven approaches to optimize available resources for moving people and goods in urban areas, in particular, provide for increased efficiency and safety “at a cost much lower than building new infrastructure from the ground up” (World Bank). Toyota’s vision of a holistic Smart Mobility ecosystem is shown in Figure 6. According to the US Department of Transportation, Intelligent Transportation Systems (ITS) – the purely technological aspect of Smart Mobility – can be defined as “the application of advanced information and communications technology to surface transportation in order to achieve enhanced safety and mobility while reducing the environmental impact of transportation. The addition of wireless communications offers a powerful and transformative opportunity to establish transportation connectivity that further enables cooperative systems and dynamic data exchange using a broad range of advanced systems and technologies.” The European Telecommunications Standards Institute, ETSI, adds that ITS include “telematics and all types of communications in vehicles, between vehicles (e.g. car-to-car), and between vehicles and fixed locations (e.g. car-to-infrastructure). However, ITS are not restricted to Road Transport – they also include the use of information and communication technologies (ICT) for rail, water and air transport, including navigation systems.”

Figure 6. Toyota’s vision of a Smart Mobility ecosystem; Source: www.toyota-global.com

The benefits are said to be wide-ranging. The European Commission claims that ITS “are vital to increase safety and tackle Europe’s growing emission and congestion problems” and that “the integration of existing technologies can create new services, [supporting] jobs and growth in the transport sector.” Tass International, a Dutch technology development organization for the mobility sector, explains that a connected, Smart Mobility infrastructure will enable the reduction of the number of traffic accidents as well as the reduction of emissions and fuel consumption while improving traffic flow. In addition to economic and environmental benefits, Smart Mobility will also entail social improvements by providing low-income population vastly improved access to urban job markets and educational systems. WRI provides an example with Medellín’s (Colombia) Metrocable system that “has transformed what was once a day-long journey from the city’s mountainous slums to its urban core into a 30-minute affair, increasing access to daily needs and empowering the city’s most disadvantaged communities.”

The network mapping analysis for Smart Mobility reveals established, cross-industrial value networks that speak of an ecosystem akin to Smart Grid (Fig. 7). Unsurprisingly, the anchor industry foundation features legacy industries that are both manufacturing and capital intensive. These include (i) wireless telecommunications as the provider of the necessary wireless and mobile data transfer infrastructure, (ii) the transportation industry (logistics) that commands ground, marine and aerial fleet assets to provide transportation services, (iii) internet retail as the sales platform and interface for purchasing mobility services in real-time on the go, (iv) the application software industry that develops mobile applications (e.g. route guides, navigation apps, and car sharing platforms) for users to navigate the interconnected mobility landscape, and technology component manufacturers, here “industrial conglomerates”, as the providers of system components for the ecosystem’s hardware infrastructure.

The catalyst industries, in turn, include the by now familiar software and IT-driven sectors such as systems software, data processing, and hardware, but now also feature sectors that in Smart Grid played the role of anchors. These are integrated telecommunications and communications equipment. It seems telecommunications operators are intent on leveraging their strong, direct link to consumers and established user interfaces to exploit opportunities in the mobility space. It is a brilliant strategy as Smart Mobility really is all about real-time information brokerage that, in contrast to Smart Grid, is easily delivered via mobile devices such as smart phones. The role of car manufacturing in the Smart Mobility ecosystem is still somewhat uncertain. According to Ford Motor Company’s projections, about 80 percent of the total value of ground vehicles will reside outside the physical vehicle within a decade if car manufacturers do not take measures to integrate the added value of Smart Mobility-related solutions into the vehicles. Ford itself has declared to pursue a repositioning strategy that will see a shift away from the drive train and chassis to the digital, interconnected dashboard as the most valuable element in a vehicle. Ford is on route to transform its identity from a car company towards a technology company.

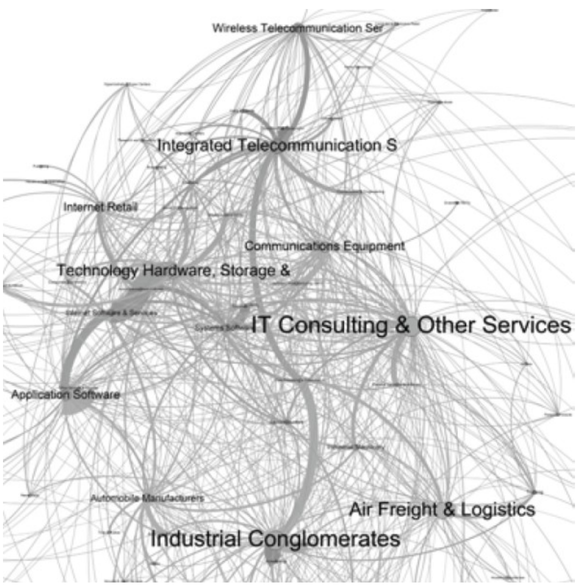

Figure 7. Smart Mobility ecosystem

On February 10 2017, Ford announced its plans to invest USD 1 billion over the next five years in Argo AI from San Francisco, an artificial intelligence start-up focused on developing autonomous vehicle technology. The move is Ford’s biggest effort to move into self-driving car research. The investment is also a way for Ford, which is more than century old, to tap into Silicon Valley talent and make headway in a competitive space. If Ford’s case is to be taken as a signal of a trend that will define the future of car manufacturing, then the sector might very well serve the role of integrator in the budding Smart Mobility ecosystem. It might well become a catalyst sector, fighting for market share with telecommunications.

Figure 7 depicts the industrial structure of the global Smart Mobility ecosystem. [12] Surprisingly, sectors associated with growth enabling catalyst functions in Smart Grids are found at the periphery of the Smart Mobility ecosystem. These include application software and internet retail. In contrast, manufacturing-centric sectors such as technology hardware, communications equipment, integrated telecommunications, and semiconductors, i.e. classic anchor industries in Smart Grids, serve the vital role of catalysts in the Smart Mobility ecosystem. Why is this?

The answer relates to the maturity of the Smart Mobility ecosystem. Compared to Smart Grids, Smart Mobility is a much younger phenomenon. The necessary, ubiquitous and interconnected infrastructure is not yet in place. The physical infrastructure for the data and software-driven services of tomorrow – including real-time traffic flow optimization, software for vehicle-to-vehicle communication, public-to-private transportation systems platforms, and integrated mobile payment systems – needs to be built out first. These systems and their seamless integration will require a lot of specialized, IoT-ready equipment; they need manufacturing. In the long-run, of course, when the hardware infrastructure is in place, services built on top of this infrastructure will generate the bulk of value added in the ecosystem, just as we have seen it happen in the more mature case of Smart Grids already.

How does the structure of the Swiss economy hold up against this backdrop? Where are its strengths in the global Smart Mobility ecosystem as depicted in the above map? Table 2 shines light on potential answers. Again, a number of insights stand out:

1) In the Swiss Smart Mobility ecosystem, the predominance of wholesalers is even more pronounced than in the case of Smart Grids. Almost 30 percent of the company base operate a trade business. With a combined 17 percent, particularly machinery, electronics and computer-related trade make up a large share of the companies. As discussed in conjunction with the results on the Smart Grid ecosystem, merchants serve a vital function in providing the national manufacturing sectors with the needed parts and subsystems, but are positioned further up in the value chain and scrape only a slice – comparable to a commission-like charge per transaction – of the gross value added generated in the ecosystem.

   Much like it was the case in the Smart Grid ecosystem, such a heavy focus on wholesale speaks of a massive influx of imports into manufacturing, which clearly specializes in high value added production, relying on imports for lower value added factors of production. High-end manufacturing, of course, is a great source of value added. Highly specialized jobs and high-margined specialty products support economic growth the most classic of senses.

2) As argued above, manufacturing is still the beating heart of the Smart Mobility ecosystem as the necessary hardware infrastructure is in the process of being built up. Many of the best known electronic component manufacturers, such as Bosch and Siemens, have publicly announced to pursue a long-term strategy that aims at positioning them in the core of smart ecosystems.

   It is absolutely key to note, however, that they are not implementing the strategy by extending their conventional, incumbent manufacturing business models. On the contrary, an ever larger share of the value added of their products is generated by embedded software that enables IoT-functionalities. In other words, these manufacturing behemoths of today are pivoting their core capabilities to be able to reap the value generated in the digital ecosystems – including Smart Mobility – of tomorrow. Ford Motor Company, as already discussed, is another great example of the paradigm shift in the incumbent manu-

[12] Adriaens, P. and A.-J. Tahvanainen. 2016. Financial Technology for Industrial Renewal. ETLA Press, Helsinki, Finland.

facturing industry.

As Table 2 clearly shows, Switzerland boasts a very strong, diverse and high value added manufacturing industry. More precisely, it holds a comparative advantage over the world in sectors such as industrial machinery, engineering services, semiconductor manufacturing, computer systems design, wired telecommunication, motor vehicle transit systems, electrical equipment manufacturing, and control device manufacturing, all of which contribute to the establishment of a hardware infrastructure for Smart Mobility solutions.

NAICS	%CH	%World	Diff.
Industrial Machinery and Equip. Merchant Wholesalers	9.2 %	2.6 %	**6.6%**
Other Electronic Parts and Equip. Merchant Wholesalers	5.6 %	1.0 %	**4.6%**
Electrical Apparatus and Equip., Wiring Supplies, and Related Equip. Merchant Wholesalers	4.1 %	1.3 %	**2.8%**
Computer and Computer Peripheral Equip. and Software Merchant Wholesalers	2.8 %	1.0 %	**1.8%**
Other Chemical and Allied Products Merchant Wholesalers	2.9 %	1.1 %	**1.8%**
All Other Industrial Machinery Manuf.	2.1 %	0.8 %	**1.3%**
Engineering Services	4.3 %	3.1 %	**1.2%**
Other Electric Power Generation	2.8 %	1.7 %	**1.1%**
All Other Professional, Scientific, and Technical Services	1.7 %	0.7 %	**1.0%**
Semiconductor and Related Device Manuf.	2.0 %	1.0 %	**1.0%**
Other Measuring and Controlling Device Manuf.	1.3 %	0.4 %	**1.0%**
Electric Power Distribution	1.8 %	0.9 %	**0.9%**
Automobile and Other Motor Vehicle Merchant Wholesalers	3.3 %	2.6 %	**0.8%**
Research and Development in the Physical, Engineering, and Life Sciences	1.6 %	0.9 %	**0.7%**
Research and Development in the Social Sciences and Humanities	0.8 %	0.2 %	**0.6%**
Computer Systems Design Services	2.3 %	1.9 %	**0.5%**
All Other Miscellaneous Chemical Product and Preparation Manuf.	1.3 %	0.9 %	**0.4%**
Wired Telecommunications Carriers	1.6 %	1.2 %	**0.4%**
Elevator and Moving Stairway Manuf.	0.5 %	0.2 %	**0.3%**
Support Activities for Rail Transportation	0.5 %	0.2 %	**0.3%**
Bus and Other Motor Vehicle Transit Systems	0.5 %	0.2 %	**0.2%**
Line-Haul Railroads	0.4 %	0.2 %	**0.2%**
Internet Publishing and Broadcasting and Web Search Portals	1.8 %	1.6 %	**0.2%**
Optical Instrument and Lens Manuf.	0.5 %	0.3 %	**0.2%**
Metal Window and Door Manuf.	0.6 %	0.4 %	**0.2%**
All Other Miscellaneous Electrical Equip. and Component Manuf.	0.9 %	0.8 %	**0.2%**
Instrument Manuf. for Measuring and Testing Electricity and Electrical Signals	0.8 %	0.7 %	**0.2%**
Scheduled Passenger Air Transportation	0.4 %	0.3 %	**0.1%**
Other Support Activities for Air Transportation	0.3 %	0.2 %	**0.1%**
Analytical Laboratory Instrument Manuf.	0.2 %	0.2 %	**0.1%**
Computer and Software Stores	0.4 %	0.3 %	**0.1%**
Power, Distribution, and Specialty Transformer Manuf.	0.4 %	0.3 %	**0.1%**
Digital Printing	0.2 %	0.1 %	**0.1%**
Automotive Parts and Accessories Stores	0.6 %	0.6 %	**0.0%**
Hydroelectric Power Generation	0.6 %	0.5 %	**0.0%**
Railroad Rolling Stock Manuf.	0.2 %	0.1 %	**0.0%**
Aircraft Manuf.	0.2 %	0.2 %	**0.0%**
Electronic Connector Manuf.	0.1 %	0.1 %	**0.0%**
Totalizing Fluid Meter and Counting Device Manuf.	0.2 %	0.1 %	**0.0%**
Inland Water Freight Transportation	0.2 %	0.2 %	**0.0%**
Tour Operators	0.4 %	0.3 %	**0.0%**
Instruments and Related Products Manuf. for Controlling Industrial Process Variables	0.3 %	0.3 %	**0.0%**
Travel Agencies	1.1 %	1.0 %	**0.0%**
Other Communications Equip. Manuf.	0.4 %	0.4 %	**0.0%**
Other Waste Collection	0.2 %	0.2 %	**0.0%**
Air Traffic Control	0.0 %	0.0 %	**0.0%**

Table 2. Sectors of Swiss strength in the global Smart Mobility ecosystem

The time is right to leverage these strengths. There is still a massive need to upgrade existing infrastructure in telecommunication, traffic control, buildings and related equipment to accommodate the needed IoT-functionalities for smarter mobility solutions.

At the same time, it is pivotal for cutting-edge manufacturing companies to be aware of the need to start a transformation towards a digital tomorrow: clever equipment providers anticipate the requirements for providing smart mobility solutions in the form of embedded software, virtualization of hardware, etc. They will integrate as many of the elements that enable the ecosystem to become intelligent into their physical products. Downstream integration into software and service-based business models will be key to success. Conventional manufacturing models built around a physical product only will be upended by agile, digital growth companies.

3) On the down side, the structure of the Swiss economy shows comparative deficiencies in a large number of sectors relevant to the emergence of the Smart Mobility ecosystem. Table 3 exhaustively lists sectors that are underrepresented in Switzerland relative to the company population in the global Smart Mobility ecosystem.

On the list are future growth sectors such as software publishing and data analytics. These will play a vital role in a more mature Smart Mobility ecosystem in the near future. In parallel to the findings regarding the Swiss Smart Grid relevant company base, the country's economy would need reinforcements in these sectors to sustain long-term growth capabilities in the Smart Mobility ecosystem.

Another major deficiency can be identified in the logistics sector. Many freight and courier services-related sectors, as well as the entire automotive and transportation vehicle industry with their sub-sectors are on the list. With the rise of Mobility as a service (MaaS) business models, existing transportation service companies have the lowest hurdle to exploit the respective growth opportunities, as their current business models, existing fleets and IT-driven logistics systems readily lend themselves to a service-based approach to transportation.

NAICS	%CH	%World	Diff.
All Other Plastics Product Manuf.	1.2 %	1.2 %	**0.0%**
Automatic Vending Machine Manuf.	0.1 %	0.1 %	**0.0%**
Custom Computer Programming Services	2.4 %	2.4 %	**0.0%**
All Other Transportation Equip. Manuf.	0.1 %	0.1 %	**0.0%**
Fiber Optic Cable Manuf.	0.1 %	0.2 %	**0.0%**
Other Airport Operations	0.1 %	0.2 %	**0.0%**
Natural Gas Distribution	0.5 %	0.6 %	**0.0%**
Motor Vehicle Body Manuf.	0.3 %	0.3 %	**0.0%**
Computer Facilities Management Services	0.2 %	0.2 %	**0.0%**
Industrial Design Services	0.0 %	0.0 %	**0.0%**
Aircraft Engine and Engine Parts Manuf.	0.1 %	0.1 %	**0.0%**
Automatic Environmental Control Manuf. for Residential, Commercial, and Appliance Use	0.1 %	0.1 %	**0.0%**
Interurban and Rural Bus Transportation	0.1 %	0.1 %	**0.0%**
Parking Lots and Garages	0.1 %	0.1 %	**-0.1%**
Printed Circuit Assembly (Electronic Assembly) Manuf.	0.1 %	0.1 %	**-0.1%**
Scheduled Freight Air Transportation	0.1 %	0.1 %	**-0.1%**
Satellite Telecommunications	0.1 %	0.2 %	**-0.1%**
Residential Electric Lighting Fixture Manuf.	0.0 %	0.1 %	**-0.1%**
Conveyor and Conveying Equip. Manuf.	0.1 %	0.1 %	**-0.1%**
Fossil Fuel Electric Power Generation	0.1 %	0.1 %	**-0.1%**
Coated and Laminated Packaging Paper Manuf.	0.2 %	0.2 %	**-0.1%**
Computer and Office Machine Repair and Maintenance	0.0 %	0.1 %	**-0.1%**
Construction Machinery Manuf.	0.3 %	0.4 %	**-0.1%**
Search, Detection, Navigation, Guidance, Aeronautical, and Nautical System and Instrument Manuf.	0.1 %	0.2 %	**-0.1%**
Current-Carrying Wiring Device Manuf.	0.0 %	0.1 %	**-0.1%**
Commercial, Industrial, and Institutional Electric Lighting Fixture Manuf.	0.0 %	0.1 %	**-0.1%**
Electronic Coil, Transformer, and Other Inductor Manuf.	0.1 %	0.1 %	**-0.1%**
Metal Tank (Heavy Gauge) Manuf.	0.0 %	0.1 %	**-0.1%**
Other Support Activities for Road Transportation	0.0 %	0.1 %	**-0.1%**
Geophysical Surveying and Mapping Services	0.0 %	0.1 %	**-0.1%**
Storage Battery Manuf.	0.1 %	0.2 %	**-0.1%**
Telephone Apparatus Manuf.	0.1 %	0.2 %	**-0.1%**
Tire Manuf. (except Retreading)	0.1 %	0.2 %	**-0.1%**
All Other Transit and Ground Passenger Transportation	0.0 %	0.1 %	**-0.1%**
Couriers and Express Delivery Services	0.1 %	0.2 %	**-0.1%**
Iron and Steel Pipe and Tube Manuf. from Purchased Steel	0.3 %	0.4 %	**-0.1%**
Other Professional Equip. and Supplies Merchant Wholesalers	0.0 %	0.2 %	**-0.1%**
Air-Conditioning and Warm Air Heating Equip. and Commercial and Industrial Refrigeration Equip. Manuf.	0.2 %	0.3 %	**-0.1%**
Electrical Contractors and Other Wiring Installation Contractors	1.7 %	1.8 %	**-0.1%**
Commercial and Industrial Machinery and Equip.Repair and Maintenance	0.2 %	0.3 %	**-0.1%**
Other Computer Peripheral Equip. Manuf.	0.2 %	0.3 %	**-0.1%**
Nonresidential Property Managers	0.1 %	0.2 %	**-0.1%**
Other Aircraft Parts and Auxiliary Equip. Manuf.	0.0 %	0.2 %	**-0.1%**
Other Building Equip. Contractors	0.2 %	0.3 %	**-0.1%**
Electronic Capacitor Manuf.	0.1 %	0.2 %	**-0.1%**
Commercial Air, Rail, and Water Transportation Equip. Rental and Leasing	0.0 %	0.2 %	**-0.2%**
Motor and Generator Manuf.	0.1 %	0.3 %	**-0.2%**
Electric Lamp Bulb and Part Manuf.	0.0 %	0.2 %	**-0.2%**
Testing Laboratories	0.3 %	0.4 %	**-0.2%**
Plumbing and Heating Equip. and Supplies (Hydronics) Merchant Wholesalers	0.1 %	0.3 %	**-0.2%**
Architectural Services	0.6 %	0.8 %	**-0.2%**
Recyclable Material Merchant Wholesalers	0.4 %	0.6 %	**-0.2%**
Wireless Telecommunications Carriers (except Satellite)	0.6 %	0.8 %	**-0.2%**
Plastics Material and Resin Manuf.	0.5 %	0.6 %	**-0.2%**
Power and Communication Line and Related Structures Construction	0.2 %	0.4 %	**-0.2%**
Prefabricated Metal Building and Component Manuf.	0.1 %	0.3 %	**-0.2%**
Other Electronic Component Manuf.	0.8 %	1.0 %	**-0.2%**
All Other Information Services	0.3 %	0.5 %	**-0.2%**
All Other Specialty Trade Contractors	1.0 %	1.2 %	**-0.2%**
Data Processing, Hosting, and Related Services	1.0 %	1.2 %	**-0.2%**
Radio and Television Broadcasting and Wireless Communications Equip. Manuf.	0.1 %	0.3 %	**-0.2%**
General Warehousing and Storage	0.3 %	0.5 %	**-0.2%**
Environmental Consulting Services	0.0 %	0.3 %	**-0.2%**
Other Scientific and Technical Consulting Services	0.2 %	0.5 %	**-0.3%**
Security Systems Services (except Locksmiths)	0.3 %	0.6 %	**-0.3%**
Construction, Mining, and Forestry Machinery and Equip. Rental and Leasing	0.1 %	0.3 %	**-0.3%**
Wholesale Trade Agents and Brokers	0.1 %	0.4 %	**-0.3%**
Audio and Video Equip. Manuf.	0.1 %	0.4 %	**-0.3%**
Fabricated Structural Metal Manuf.	0.6 %	0.9 %	**-0.3%**
Marine Cargo Handling	0.0 %	0.3 %	**-0.3%**
Other Computer Related Services	0.9 %	1.2 %	**-0.3%**
Water and Sewer Line and Related Structures Construction	0.2 %	0.5 %	**-0.3%**
Site Preparation Contractors	0.5 %	0.9 %	**-0.3%**
Industrial Supplies Merchant Wholesalers	0.0 %	0.4 %	**-0.4%**
Security Guards and Patrol Services	0.1 %	0.5 %	**-0.4%**
Highway, Street, and Bridge Construction	0.9 %	1.4 %	**-0.4%**
Water Supply and Irrigation Systems	0.2 %	0.6 %	**-0.4%**
Oil and Gas Pipeline and Related Structures Construction	0.1 %	0.6 %	**-0.5%**
Motor Vehicle Supplies and New Parts Merchant Wholesalers	0.3 %	0.9 %	**-0.5%**
Lessors of Nonresidential Buildings (except Miniwarehouses)	0.1 %	0.6 %	**-0.6%**
Software Publishers	3.3 %	3.9 %	**-0.6%**
Freight Transportation Arrangement	0.4 %	1.0 %	**-0.7%**
Other Heavy and Civil Engineering Construction	0.4 %	1.1 %	**-0.7%**
General Freight Trucking, Long-Distance, Truckload	0.0 %	0.7 %	**-0.7%**
General Freight Trucking, Local	1.1 %	1.9 %	**-0.8%**
Deep Sea Freight Transportation	0.4 %	1.3 %	**-0.9%**
All Other Motor Vehicle Parts Manuf.	0.2 %	1.2 %	**-1.0%**
Software Reproducing	1.6 %	2.6 %	**-1.0%**
All Other Telecommunications	2.2 %	3.2 %	**-1.0%**
Land Subdivision	0.1 %	1.4 %	**-1.2%**
All Other Business Support Services	1.0 %	2.6 %	**-1.6%**
Commercial and Institutional Building Construction	0.6 %	2.6 %	**-2.0%**
New Car Dealers	0.5 %	3.5 %	**-3.0%**
Lessors of Other Real Estate Property	0.9 %	4.0 %	**-3.2%**

Table 3. Sectors of weakness in the global Smart Mobility ecosystem

4.4 Benchmark: eHealth Ecosystem

NAICS	#CH	%CH	%World	Diff.
Drugs and Druggists Sundries Merchant Wholesalers	712	12.2 %	2.3 %	9.9 %
Computer and Computer Peripheral Equip. and Software Merchant Wholesalers	261	4.5 %	1.7 %	2.8 %
Pharmaceutical Preparation Manuf.	321	5.5 %	3.6 %	2.0 %
Engineering Services	404	6.9 %	5.3 %	1.6 %
All Other Professional, Scientific, and Technical Services	161	2.8 %	1.2 %	1.6 %
Other Measuring and Controlling Device Manuf.	124	2.1 %	0.6 %	1.5 %
Semiconductor and Related Device Manuf.	184	3.2 %	1.7 %	1.5 %
Research and Development in the Physical, Engineering, and Life Sciences	147	2.5 %	1.5 %	1.0 %
Research and Development in the Social Sciences and Humanities	77	1.3 %	0.3 %	1.0 %
Electromedical and Electrotherapeutic Apparatus Manuf.	87	1.5 %	0.5 %	1.0 %
Construction and Mining (except Oil Well) Machinery and Equip. Merchant Wholesalers	79	1.4 %	0.7 %	0.7 %
All Other Miscellaneous Ambulatory Health Care Services	123	2.1 %	1.5 %	0.6 %
Computer Systems Design Services	218	3.7 %	3.2 %	0.5 %
Surgical and Medical Instrument Manuf.	114	2.0 %	1.4 %	0.5 %
Wired Telecommunications Carriers	147	2.5 %	2.1 %	0.5 %
Homes for the Elderly	44	0.8 %	0.4 %	0.4 %
All Other Publishers	28	0.5 %	0.2 %	0.3 %
Business to Business Electronic Markets	25	0.4 %	0.2 %	0.2 %
Medical Laboratories	41	0.7 %	0.5 %	0.2 %
Internet Publishing and Broadcasting and Web Search Portals	171	2.9 %	2.7 %	0.2 %
Offices of All Other Miscellaneous Health Practitioners	47	0.8 %	0.7 %	0.1 %
Printing Machinery and Equip. Manuf.	19	0.3 %	0.2 %	0.1 %
Computer and Software Stores	40	0.7 %	0.6 %	0.1 %
In-Vitro Diagnostic Substance Manuf.	10	0.2 %	0.1 %	0.0 %
Voluntary Health Organizations	4	0.1 %	0.1 %	0.0 %
Photographic and Photocopying Equip. Manuf.	11	0.2 %	0.2 %	0.0 %
Commercial Lithographic Printing	32	0.5 %	0.6 %	0.0 %
Research and Development in Biotechnology	31	0.5 %	0.6 %	0.0 %
Other Communications Equip. Manuf.	42	0.7 %	0.7 %	0.0 %
Offices of Mental Health Practitioners (except Physicians)	1	0.0 %	0.0 %	0.0 %
Electronic Computer Manuf.	31	0.5 %	0.6 %	0.0 %
Book, Periodical, and Newspaper Merchant Wholesalers	10	0.2 %	0.2 %	0.0 %
Industrial Design Services	1	0.0 %	0.1 %	-0.1 %
Printing Ink Manuf.	4	0.1 %	0.1 %	-0.1 %
Computer Facilities Management Services	15	0.3 %	0.3 %	-0.1 %
HMO Medical Centers	1	0.0 %	0.1 %	-0.1 %
Third Party Administration of Insurance and Pension Funds	3	0.1 %	0.1 %	-0.1 %
Offices of Physical, Occupational and Speech Therapists, and Audiologists	1	0.0 %	0.1 %	-0.1 %
Printed Circuit Assembly (Electronic Assembly) Manuf.	7	0.1 %	0.2 %	-0.1 %
All Other Health and Personal Care Stores	9	0.2 %	0.3 %	-0.1 %
Satellite Telecommunications	9	0.2 %	0.3 %	-0.1 %
Offices of Physicians, Mental Health Specialists	1	0.0 %	0.1 %	-0.1 %
Lessors of Nonfinancial Intangible Assets (except Copyrighted Works)	6	0.1 %	0.2 %	-0.1 %
Diagnostic Imaging Centers	6	0.1 %	0.2 %	-0.1 %
Telephone Apparatus Manuf.	9	0.2 %	0.3 %	-0.2 %
Couriers and Express Delivery Services	12	0.2 %	0.4 %	-0.2 %
Direct Health and Medical Insurance Carriers	34	0.6 %	0.8 %	-0.2 %
Other Social Advocacy Organizations	8	0.1 %	0.3 %	-0.2 %
All Other Outpatient Care Centers	3	0.1 %	0.3 %	-0.2 %
Custom Computer Programming Services	227	3.9 %	4.1 %	-0.2 %
Television Broadcasting	58	1.0 %	1.2 %	-0.2 %
Other Computer Peripheral Equip. Manuf.	17	0.3 %	0.5 %	-0.2 %
Biological Product (except Diagnostic) Manuf.	14	0.2 %	0.5 %	-0.2 %
Financial Transactions Processing, Reserve, and Clearinghouse Activities	34	0.6 %	0.8 %	-0.2 %
All Other Insurance Related Activities	13	0.2 %	0.5 %	-0.2 %
Other Residential Care Facilities	4	0.1 %	0.3 %	-0.3 %
Other Direct Insurance (except Life, Health, and Medical) Carriers	11	0.2 %	0.5 %	-0.3 %
Wireless Telecommunications Carriers (except Satellite)	58	1.0 %	1.3 %	-0.4 %
Educational Support Services	11	0.2 %	0.5 %	-0.4 %
Radio and Television Broadcasting and Wireless Communications Equip. Manuf.	7	0.1 %	0.5 %	-0.4 %
All Other Information Services	26	0.4 %	0.8 %	-0.4 %
All Other Support Services	6	0.1 %	0.5 %	-0.4 %
Pharmacies and Drug Stores	74	1.3 %	1.7 %	-0.4 %
Other Electronic Component Manuf.	79	1.4 %	1.8 %	-0.4 %
Data Processing, Hosting, and Related Services	90	1.5 %	2.0 %	-0.5 %
Other Scientific and Technical Consulting Services	21	0.4 %	0.8 %	-0.5 %
Security Systems Services (except Locksmiths)	28	0.5 %	1.0 %	-0.5 %
All Other Personal Services	11	0.2 %	0.7 %	-0.5 %
Business Associations	35	0.6 %	1.2 %	-0.6 %
Motion Picture and Video Production	32	0.5 %	1.2 %	-0.6 %
Other Computer Related Services	81	1.4 %	2.1 %	-0.7 %
Security Guards and Patrol Services	12	0.2 %	0.9 %	-0.7 %
Radio Networks	8	0.1 %	0.8 %	-0.7 %
Medical, Dental, and Hospital Equip. and Supplies Merchant Wholesalers	35	0.6 %	1.3 %	-0.7 %
Direct Property and Casualty Insurance Carriers	26	0.4 %	1.2 %	-0.8 %
Home Health Care Services	3	0.1 %	1.0 %	-1.0 %
Freight Transportation Arrangement	33	0.6 %	1.7 %	-1.2 %
Software Publishers	305	5.2 %	6.6 %	-1.4 %
Offices of Physicians (except Mental Health Specialists)	6	0.1 %	1.5 %	-1.4 %
Administrative Management and General Management Consulting Services	70	1.2 %	2.7 %	-1.5 %
General Medical and Surgical Hospitals	73	1.3 %	2.8 %	-1.6 %
Software Reproducing	154	2.6 %	4.5 %	-1.9 %
All Other Telecommunications	203	3.5 %	5.4 %	-1.9 %
All Other Business Support Services	90	1.5 %	4.4 %	-2.9 %

Table 4. Switzerland’s relative strengths (blue) and weaknesses (red) in eHealth

eHealth is yet another emerging ecosystem that the Swiss government has identified as a pillar of national strategy. According to the definition put forth by the European Commission, eHealth “refers to tools and services using information and communication technologies (ICTs) that can improve prevention, diagnosis, treatment, monitoring and management; can benefit the entire community by improving access to care and quality of care and by making the health sector more efficient; and includes information and data sharing between patients and health service providers, hospitals, health professionals and health information networks; electronic health records; telemedicine services; portable patient-monitoring devices, operating room scheduling software, robotized surgery and blue-sky research on the virtual physiological human.”

The Commission further issues that the goals it pursues by promoting the development of eHealth solutions are (a) “to improve citizens' health by making life-saving information available – between countries when necessary – using eHealth tools; (b) to increase healthcare quality and access by making eHealth part of health policy and coordinating EU countries' political, financial and technical strategies; and (c) to make eHealth tools more effective, user-friendly and widely accepted by involving professionals and patients in strategy, design and implementation.”

While not in the core focus of the Swiss Federal Office of Energy, given the country’s prowess in drug development and its excellent health care system, eHealth might provide a major opportunity to leverage these strengths in the global arena and claim a strong position in the emerging ecosystem.

Table 4 provides initial insights into Switzerland’s relative strengths (blue) and weaknesses (red) in eHealth: Switzerland’s classic profile in drug development and trade is easy to spot. Pharmaceutical wholesale is vastly overrepresented compared to the share of pharmaceutical wholesalers in the global population of companies. Pharmaceutical preparation manufacturing – drug development, in more colloquial terms – is equally high on the list of sectors with a comparative advantage. The national pharma industry is backed up by a strong research and development service industry that outshines the rest of the world in its density in Switzerland.

One could say Switzerland boasts a very strong drug development value chain starting with research upstream, and ending in the global market place with the drug retail sector all the way downstream. There is no question as to whether pharmaceuticals are a stronghold of the Swiss economy.

That being said, there is very little evidence of a local, IT-backed eHealth ecosystem. Basically, all IT- and data-related sectors are absent from the list of sectors with a comparative advantage. Unfortunately, they can be all found in the parts of the list highlighted in red. The findings echo those gained from the Smart Grid and Smart Mobility ecosystems: the Swiss economy is not yet structured and geared towards becoming “smart”.

4.5 Recommendations

- The Swiss economy, overall, is highly manufacturing centric. IT- and data-driven sectors are generally underrepresented in the country’s economic structure. Unfortunately, most emerging ecosystems are grown out by these sectors that sustain themselves on digital business models.
- The manufacturing centricity might soon, if not already, become the ball and chain to Switzerland’s ability to capture the value offered by new growth in smart ecosystems.

- While building up entirely new, digitally driven sectors in Switzerland from scratch is not a viable short-term strategy, incumbent industry must be encouraged to and supported in adopting strategies that aim at extending their business models further downstream via partnering with digital growth companies or acquiring them. Currently, such strategies are still viable as the innovative but small growth companies are reliant on the industrial heavy-hitters for market access and capital-intensive assets. In a few years when they have grown beyond their fragile size, it might just be too late.

- It is timely and worth-wile to actively explore synergies and collaboration opportunities with digitalization initiatives on global and national levels – e.g. DigitalSwitzerland, etc. - for Swiss stakeholders and actors in the Smart Grid and Smart Mobility ecosystems.

5. Stakeholder Engagement and Consulting

5.1 Goals, Approach

An important goal of the project Potential Analysis Cluster Ecosystems was to identify and engage with the relevant key stakeholders in Switzerland that potentially could be interested to further drive the Fintech and Cleantech topic in general, and the MARF topic in particular. This capacity building effort is critical for the design and realization of a potential MARF program in Switzerland with the Phase II (Micro-level Analysis) and Phase III (Fund Structuring).

Stakeholders include the private sector and public sector. However, to realize the MARF Phases II and III the focus is on private sector partners and stakeholders.

The project goal and approach was two-fold:

- Realize *bilateral meetings* and discussions with relevant stakeholders and representatives of potentially interested stakeholder groups and organizations. Bilateral meetings allow for open discussions with all stakeholder groups, with no publicity. Therefore also sensitive topics can be addressed and discussed.

- Realize an *informal Fintech Cleantech Forum* with 30 participants, based on the learnings of the bilateral meetings - by invitation only and with limited publicity. This allows for open discussions in a trusted environment.

This 2-step approach proved to be very successful. The learnings and conclusions of the bilateral meetings were integrated to design the detailed program of the first Fintech Cleantech Forum realized on November 22, 2016 in Zurich. The following chapter 5.2 describes the results of the informal Fintech Cleantech Forum in detail.

5.2 Informal Fintech Cleantech Forum, November 22nd 2016, Zurich

5.2.1 Goals and Program

Goal of the Fintech Cleantech Forum was to explore potential synergies and new business opportunities for Swiss entrepreneurs and organizations at the intersection of Fintech and Cleantech. A particular focus was to explore opportunities with regards to finance solutions supporting the deployment of innovative low carbon technologies, at scale.

In recent years the topics Fintech and Cleantech were not yet developed with a joint strategic focus. Accordingly, the Forum participants were carefully selected, covering all relevant target groups and reaching out to proven Swiss entrepreneurs and innovators. To include international benchmark knowhow and best practice expertise, three participants from Germany, Finland and the US were invited to join the Forum in Zurich. To allow for engaging and interactive working sessions, a maximum of 32 top-level participants was defined.

5.2.2 Outcomes, Next Steps

The achieved results by far exceeded the expectations of the organizers of this first ever Fintech Cleantech Forum in Switzerland. Concrete strategic corner stones for a mid/long-term strategy as well as realistic short-term action items were developed and identified. More than 50% of the participants want to actively participate and contribute to the further development of the Fintech Cleantech topic in Switzerland. 100% of the participants are interested to participate in a next Fintech Cleantech Forum in 2017, and want to be informed about concrete next steps, e.g. the potential action item Fintech Cleantech Hackathon in Zurich. Such clear support was not to be expected for a rather interdisciplinary and complex topic and proves the potential for Swiss entrepreneurs, and the Swiss economy in general.

Therefore the organizers of the first Fintech Cleantech Forum decided to kickoff the planning tasks for a second Fintech Cleantech Forum, as well as the Fintech Cleantech Hackathon in Q3/2017 as two concrete next steps and action items. This is also fully in line with the Green Digital Finance Alliance launched at the WEF Davos in January 2017, and the vision of DigitalSwitzerland.

The economic and strategic positioning potential for Switzerland at the intersection of Fintech and Cleantech can be described with three key outcomes of the Forum:

1. Switzerland is one of the world's leading finance hubs with highly sophisticated finance knowhow. Nevertheless, the mega-trends digitalization and decentralization lead to significant innovation pressure for traditional multi-national corporates, SMEs as well as young Startups. Within increasingly short timespans new strategic growth markets and unique selling propositions need to be identified and developed.

2. In the coming decades, Switzerland needs to invest Billions from private and institutional investors into the modernization and decentralization of the Swiss energy infrastructure (production, storage, distribution). The Energy Strategy 2050 and the phase out of the nuclear power are political corner stones in this inevitable transition process, and will allow Switzerland to regain lost ground over the last 20 years compared to the worlds leading sustainable economic regions. These investments would lead to a strong home market for sustainable entrepreneurs and investors in Switzerland. On May 21 2017 the Federal Referendum regarding the Energy Strategy 2050 will determine the strategic and operational path for the years to come.

3. The demographic development with an increasingly aging Swiss population combined with instable global financial markets, ongoing massive quantitative easing programs by Central Banks, and low or even negative interest rates lead to a historic innovation pressure for institutional investors, e.g. pension funds. They are looking for future-proof resilient business models, services and investment alternatives.

In a first interactive, engaging working sessions potential Vision and Goals for the Fintech Cleantech topic with a time horizon of 2 years were developed. Based on these results the second working sessions set was focused on developing ideas and concrete measures that could be realized within 6 months, until June 2017. Key results are described below.

Vision and Goals, time horizon 2 years

- Assess the regulatory and political framework developments with time horizon 2019. If necessary and/or possible: timely inputs to support the inclusion of the Fintech Cleantech topic in the political discussions.
- Develop a national Meta-discourse and overall strategy as a Multi-stakeholder dialogue – prevent and avoid fragmented strategies on regional levels.
- Design Fintech Cleantech lighthouse projects to broadly communicate and explain the topic publicly
- Include the Fintech Cleantech topic in a timely and pro-active manner in the Blockchain discussion in Duebendorf (e.g. project TrustSquare)
- Develop and include the topic as a WTT/Technology Transfer model and align the topic with export strategies and activities (e.g. with a focus on emerging markets, aligned with existing successful Swiss initiatives in those markets)
- Include Cooperatives and Family Offices in the Fintech Cleantech activities.

Measures, time horizon 6 months

- January 2017: assess the political discussion and framework process regarding the match of the Fintech Cleantech topic for the innovation park Duebendorf, and actively provide inputs accordingly.
- Realization of a first ever Fintech Cleantech Hackathon in fall 2017.
- Realize a prototype website for the Fintech Cleantech topic, as a base for further discussions and decisions with regars to communication and positioning of the Fintech Cleantech topic.
- Provide a contact list with key players and stakeholders for the Fintech Cleantech topic in Switzerland.
- Realize smaller workshops with 4-5 participants to expand on identified key topics and priority action items, e.g. blockchain and infrastructure investments.
- Develop public awareness for the topic with interviews, articles, etc. – distributed through already existing communicatin channels of Forum participants (newsletters, websites, magazines, etc.)
- Identify international events and platforms that support and allow to further drive the Fintech Cleantech topic and a respective positioning of Switzerland in this global growth market. Examples: CeBit 2017 in Hannover, GLOBE 2018 in Vancouver, etc.

After a first assessment the provided Forum inputs will be further developed in the coming months, in close collaboration with the Forum participants. A detailed action plan will be developed as a base for further discussion among the key stakeholders, experts and organizations.

5.3 Recommendations

- The first Fintech Cleantech Forum proved to be a success and clearly addressed a need in the Swiss Fintech and Cleantech landscape. In 2017, a second Forum should be organized to further develop the initiated multi-stakeholder dialogue and platform.

- Selected sub-groups should be formed to further drive the development of the described vision, goals, and short-term measures.

- To include leading experts from abroad – besides the majority of participants joining from Switzerland – added significant insights and value to the Forum. Practical benchmarking insights from foreign markets will only accelerate the decision making process in Switzerland. As an option, strategic partnerships with international Swiss and/or foreign organizations could be developed to strengthen the international know-how exchange, and to prepare the potential export of Swiss Fintech Cleantech solutions.

- The additional insights gained through the discussions with blockchain experts further strengthened the assessment of previous years: it is critical for Swiss decision makers to understand the core and importance of this new technology – Blockchain-based solutions are likely to become a major driver of future decentralized energy infrastructure systems.

6. Conclusion

The first MARF Programs were launched as pilot projects in 2013 in Finland. At the time, discussions about a similar initiative with stakeholders in Switzerland did not prove to be successful. Today, the timing seems to be ideal:

- We can build on three years of learnings and benchmarking results from the Finnish MARF programs. We can benchmark with a MARF program that was initiated in January 2017 for the Great Lakes Region in Michigan, which will allow to leverage learnings from the first time also from Europe to the US, and vice versa.

- The Potential Analysis of Cluster Ecosystems in Switzerland allowed to identify and analyze two emerging cluster ecosystems – Smart Grids and Smart Mobility – in more detail. With this, first elements of the tasks in Phase I (macro-level) of a MARF program are realized, and relevant insights were gained.

- The multi-stakeholder dialogue with Swiss and foreign key experts was successfully initiated with the first ever Fintech Cleantech Forum in Switzerland on November 22, 2016 in Zurich. The organizers of the first Fintech Cleantech Forum decided to kickoff the planning tasks for a second Fintech Cleantech Forum, as well as the Fintech Cleantech Hackathon in Q3/2017 as two concrete next steps and action items.

- In Switzerland, digitalization - including topics like Blockchain, Fintech, Green Digital Finance, Trusted Internet, etc. – arose as a theme of national importance and urgency, e.g. with the launch of DigitalSwitzerland in November 2016. Personal contacts among key actors in the digitalization and the Cleantech space have been established, thus connecting Fintech and Cleantech on a practical level.

- The promising results and timing will allow to now engage in detailed discussions with private sector stakeholders and institutional investors in Switzerland to explore the appetite and opportunities for a MARF Program Phase II (micro-level) and Phase III (fund structuring). Concrete follow up meetings with institutional investors are prepared for March 2017.

- Last but not least, the gained insights and results allow for informed decisions to further develop the supporting regulatory and political frameworks in Switzerland. The launch of the Green Digital Finance Alliance at the WEF Davos in January 2017 and the activities of DigitalSwitzerland could prove to be an ideal base to build a globally anchored, national Meta-discourse and overall strategy as a Multi-stakeholder dialogue in order to prevent and avoid fragmented strategies on regional levels.

The three key findings described in chapter 5.2.2 – repositioning of Switzerland as a world leading financial hub, multi-billion private investments in a renewed Swiss energy infrastructure, and the innovation pressure for institutional investors - provide a historic framework to further explore the MARF and Energy Strategy 2050 discussion and are a clear invitation to approach and explore potential synergies in a pro-active, strategic manner.

About the GCCA - Global Cleantech Cluster Association

Vision of the Global Cleantech Cluster Association (GCCA) is to drive sustainable regional economic development, on a global scale. GCCA is based in Zurich and brings together 53 Cluster partners from 30 countries, representing more than 10,000 companies.

Since the launch of GCCA in 2010 a focus task is the development of new financial mechanisms to enable large-scale commercial deployment of proven technologies. Goal is to provide an investment alternative at appropriate risk and return expectations for institutional investors, e.g. pension funds.

Based on GCCA's meta-cluster insights and the close collaboration with Corymbus Inc. from Ann Arbor, Michigan the concept of Multi-Asset Renewal Funds (MARF) was developed. The first MARF programs are pilot tested since 2013 in Finland, and since 2016 in the Great Lakes Region in the US with the Blue Growth Fund (under development).

With the project at hand - the Potential Analysis of Cluster Ecosystems in Switzerland - the first elements of Phase I (macro-level) of a MARF program can be leveraged and realized in Switzerland.