The Role of Public-Private Partnerships (PPP) in Transmission Grid Infrastructure

Introduction

The current electricity system is undergoing a fundamental shift. The pressing issue of climate change has brought forth key targets and policy objectives to ensure for a competitive, secure and low-carbon economy. The imperative to decarbonize the power system has strengthened the need for greater renewable energy resources within the generating capacity. However, solely committing to expanding generation would achieve little if the electricity grid were unable to absorb and transport the clean and lower-cost power. Hence, to fully benefit from greater clean energy proliferation, the importance of continuous improvement and expansion of both transmission and distributed (T&D) lines cannot be underestimated. As grid development efforts are posed with numerous challenges, governments are increasingly turning towards the private sector to aid in closing the infrastructure deficit and the provision of public services. The emergence of Public-Private Partnerships (PPPs) in the infrastructure sector provides an opportunity for new grid strategies, sustainable investment measures, and overall more resilient grid services. This research paper will challenge the traditional views of the role of the government and the private sector in transmission grid infrastructure projects. The report will first outline how the current limitations in the legal framework, investment solutions and environmental implications of transmission expansion projects remain and in turn, how PPP integration in financing, construction and operation of transmission grid lines can aid in resolving these challenges to realize infrastructure projects.

What is PPP?

The infrastructure sector is still primarily considered a public sector concern. Public investment in transmission projects trumps that of the private sector. However, the rise of tighter public budgets, performance issues and overall delays in infrastructure projects have renewed the interest in private sector involvement. A Public-Private Partnership (PPP) can be defined as a long-term contractual agreement between a private and public entity. The objective is to deliver a public infrastructure project and service using private sector resources in return for some form of public assets, funds or user fees. The expected advantages of introducing the private sector in infrastructure project development are ensuring improved cost- and time efficiency from harnessing the market, while benefiting from a lower risk profile and cost of capital from government backed projects. In this arrangement, the private partner should not only provide the financial strength but also a critical performance-based competence to facilitate project execution of public tasks. There is considerable variety among PPP structures in order to find the best-suited option for the specific country, sector and project.

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Current Challenges in Austria’s electricity market:

The 2002 established joint German- Austrian bidding zone defined a uniform wholesale electricity price for the entire regional market. Europe’s most liquid power market accounts for two-thirds of total regional trading volumes. Between the two countries, electricity trades freely beyond the physical constraints of the transmission network capacity, exceeding 10GW at certain times.\(^4\)

The German- Austrian common market has faced challenges in changing load requirements from increased renewable energy deployment and a departure of conventional thermal power units and nuclear power plants. The current network situation is shaped by Germany’s changing power landscape. The generous feed-in tariff subsidy under the German Energiewende allowed for rapid, large-scale deployment of renewable energy sources through a fixed generation payment within the power system. All FIT-supported clean power became decoupled from day-ahead spot prices and instead, RES power gets settled through power supply bids or reduced load demand bids in the European Power Exchange (EPEX) market.\(^5\) This caused the zone’s wholesale electricity prices to fall and in turn, shifts the merit order curve, pushing conventional power plants with higher marginal production costs to the margin. This merit-order effect paired with renewable energy priority dispatch posed a threat to the profitability of conventional units, adequate investment decisions in generation capacity and increased requirements for balancing efforts of network operations. Austria also faces massive green electricity expansion, as laid out in the Green Electricity Act 2012. Installed wind power capacity is expected to triple from 1000 MW in 2010 to 3000 MW by 2020.\(^6\) The Green Electricity Act 2012 further set a target to raise photovoltaic electricity generation by 1200 MW. These ambitious goals of the Austrian federal government of generating one hundred percent of electricity needed from clean energy sources requires high-capacity power grids to connect renewable energy sources to load centers and storage plants.

The respective energy regulators decided to split the common market zone between Austria and Germany and implement congestion management on the border from 1 October 2018 to cure inefficiencies and increase welfare gains from separate zones. This decision comes from grid stability concerns as trade volumes between Austria and Germany continuously exceeds capacity and in turn spills over to third neighboring systems. The increased renewable deployment in the form of wind generation in the North and the accompanying nuclear phase out as base load capacity in the South has revealed bottlenecks between the North- South transmission lines. This causes inadequate price signals, as low power prices from large renewable generation do not account for grid constraints. Moreover, conventional power plants are unable to timely react to the actual demand as it deviates from the regional balance of load and generation of the past.\(^7\) The transmission grid infrastructure as of now is insufficient and expansion is lagging behind the requirement. In turn, during peak wind generation in the North, the vulnerability of the system

\(^4\) Germany-Austria power zone split special report (Publication). (2017). Retrieved April 22, 2018, from Argusmedia.com website
\(^5\) Germany-Austria power zone split special report (Publication). (2017). Retrieved April 22, 2018, from Argusmedia.com website
\(^7\) Loop flows challenge market integration (Rep.). (2013). Retrieved April 22, 2018, from THEMA Consulting Group website
requires the costly curtailment or re-dispatch of power generation. With re-dispatch, plants are ramped up or down based on the transmission system operators (TSOs) demand regardless of insufficient market prices. Moreover, Austria benefits from cheap flows as they store the energy through their pumped-hydro storage facilities and resell electricity to German customers at a high price during low renewable energy dispatch times. These incurred costs of dispatch are borne by the TSOs and ultimately German end users.

According to the Federal Network Agency, during peak wind production trade volumes from Germany to Austria equal to 10 GW mismatching the physical inter-connector capacity. As a consequence, the scheduled power flows diverge from the physical flows. These unscheduled flows from surplus power travel as loop flows cross borders through the external areas of Poland and Czech Republic into Austria. Thus, the Transmission System Operators (TSOs) of the host countries are required to apply actions to ensure domestic operational security. This raises host countries’ costs through required re-dispatch and loss of capacity for market trade. As indicated by Figure 4, host countries experience a welfare loss, while Germany lacks the incentive to alleviate these issues. Consequently, this situation evoked the affected neighboring countries to demand a thorough analysis by the Agency for the Cooperation of Energy Regulators (ACER). The subsequent recommendation proposed an end to the uniform bidding zone and ultimately spurred this debate within the European power sector.

Transmission Network Infrastructure in Austria

The Austrian Power Grid (APG) operates and manages the national transmission grid network and is part of the trans-European transmission grid of the Regional Group Continental Europe (RGCE) of the European Network of Transmission System Operators for Electricity (ENTSO-E). As the electricity network operator, APG guarantees non-discriminatory and full access to the liberalized Austrian power market. APG has the legal mandate to operate and maintain the over 6,700 km high voltage grid with levels 110, 220 and 380kV. The high-voltage 380 kV lines are separated into two operation regions: North & West and South & East. Given the current developments of greater volatile clean energy proliferation, advancement of digitalization and the objective of close integration of the European power market, the transmission grid operators are facing increased requirements for strong transmission infrastructure for a sustained power supply. Providing secure power supply has become a continuous balancing act for APG. Although APG spends the highest dedication, the European Union standard for “n-1 criterion” security is at the moment not consistently guaranteed.

The APG’s Masterplan 2030 determined three key scenarios to assess the need for capacity building in transmission infrastructure. The guiding reference scenario is based on both European 20-20-20 and national targets. Both the green and red scenarios diverge from the reference case. The Green scenario provides a more aggressive clean energy proliferation case,
while the Red scenario displays a more conservative approach. An essential finding of the simulation analysis of the current system capacity revealed that under all key scenarios critical weak points and bottlenecks occur. The infrastructure deficit stresses the importance of the development of planned projects to ensure reliable flow of service. The APG announced the Network Development Plan (NDP) 2017 to inform all relevant stakeholders of current assets in need of expansion and upgrade to ensure supply security, realization of climate targets and greater European market integration. The network of European transmission grid operators (ENTSO-E) confirmed this need by expressing a crucial requirement of transmission optimization investment equaling to 150 billion Euros in the next 15 years. In Austria, APG calls for EUR 2 billion grid investment over the coming next ten years. This is extremely critical, as in Austria the transmission build up did not keep up with the rising power demand. The current infrastructure (220 kV lines) is too old and limited in capacity to meet these changing conditions.

As a consequence, the European Energy Infrastructure Act has defined around 100 grid infrastructure projects, five of which are APG transmission plans that are classified as Projects of Common Interest (PCI) to power market interest. Based on the grid development status in 2012, APG announced ten critical projects to eliminate identified bottlenecks and spur sustainable growth. The two key infrastructure projects of today are the 380 kV Salzburg line and the 380 kV line Germany. The first 46km section of the Salzburg line was constructed and is already in operation since 2011. The second section will close the supply gap to West-Austria and will ultimately relieve current performance limits with the formation of the 390 kV security ring as seen in Figure 1. The entirety of the project structure will be overhead lines rather than underground cabling. The design of 380-kV security ring fundamentally requires fewer power lines, which in effect will reduce the project’s resource usage. The the geographic location of crucial load centers in Vienna, Linz and Salzburg and major generation units further supports a ring-like design. Moreover, the planned grid connection node St. Peter to Germany is a crucial addition to energy transition efforts. Clean power can be safely transported from the renewable resource-rich North to pump-storage hydroelectricity power plants in the Alps. Austria has a central geographic location and in turn, its grid network is crucial in guaranteeing a continued reliable supply for electricity consumers.

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Framework Challenges for Grid Expansion

Austria faces significant challenges in its objective of network grid expansion laid out in APG’s Network Development Plan 2017 based on the long term Masterplan 2030 strategy. We define three key obstacles of legal, investment and environmental factors that have undermined a cost-efficient and timely delivery of infrastructure project development. These three factors offer insight on why potential controversies arise from highly capital-intensive projects in transmission.

1. Legal
A significant hurdle in achieving the necessary reinforcements in the transmission grids is the duration of current permitting procedures. The permitting and siting of long-distance projects face competing jurisdictional legislation and in turn, makes the process too complex and lengthy. The current bureaucracy requires that the project development process be in line with both federal and provincial legislation. Often these have varying requirements in areas like technology, spatial planning and the level of public participants. Discussions between states (Bundesländer) and federal authorities not only extended the project length but also increased the risk of misaligned, overlapping efforts.

In 2009, Germany tried to address these challenges through implementing crucial legislative instruments for transmission expansion efforts. \(^{14}\) The Grid Expansion Acceleration Act (NABEG) 2011 introduced measures to improve project execution by reducing the time to

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\(^{13}\) Masterplan 2030. APG , 2012, pp. 1–46, Masterplan 2030.

plan and approve the expansion process. The reform appointed BNetz A as the leading body responsible for planning and approving inter-regional high voltage grid lines.\textsuperscript{15} This development towards a centralized system reduces the procedure from a minimum of 10 years to a targeted four. Moreover, the Energy Industry Act (EnWG) demands annual updates to the required 10-year grid development plan by the four TSOs. Moreover, this federal framework further limits disputes over transmission projects to the Federal administrative Court in Leipzig.\textsuperscript{16} These efforts have enabled an acceleration of the planning and approval process, however challenges remain.

Austria can benefit and learn from Germany’s experience in improving current legal conditions. An essential factor in resolving the legal framework challenge causing approval delays is laying the foundation of a principal PCI definition. Projects that are classified as critical to the climate initiative undergo a quicker, transparent and easier approval procedure to be handled by a central federal authority body.\textsuperscript{17} Currently, the non-compliance to set deadlines is fueled by continued acceptance and submission of appeals throughout the Environmental Impact Assessment (EIA) procedure. To avoid any delaying tactics, APG stresses the need for a set legal submission deadline rather than accepting petitions without any time restrictions. Moreover, there needs to be discussion among all parties about a possible alteration of the current EIA to simplify the process itself while ensuring full upkeep of environmental standards and objectives.

2. Investment
The required investment volume for APG’s Master Plan 2020 expansion projects is expected to be 1.4 billion EUR. 600 billion EUR of the total investment package will be designated for the development of the second section of the 380-kV Salzburg line.\textsuperscript{18} The capital intense nature of transmission infrastructure requires a sound long-term financial basis of the company to further project development. However, the implemented network tariff design does not incorporate the current energy industry developments and in turn, requires a tariff reform to safeguard future-oriented expansion. Transmission charges make up a third of the total customer charge and in turn, require alterations to ensure a regulated cost recovery. Nevertheless, investment in transmission capital is still deemed risky, given continuous project delays, high up-front costs and subsequent uncertain returns on investment. Consequently, the high uncertainty of cost recovery has reduced investment inflows. Since the 2008 Financial Crisis, bank loans for project financing purposes have been limited. Capital market financing has become a popular alternative to the traditional banking


\textsuperscript{17} Masterplan 2030. APG, 2012, pp. 1–46, *Masterplan 2030*.

business; however raising funds this way still remains difficult. Creative solutions are required to access financing and mitigate the rate increase for payers.

3. Environmental
A central challenge is continued opposition of planned transmission expansion projects. The backlash from various environmental organizations, states and local communities requires continued dialogue to explain the need for infrastructure to facilitate the shift towards non-conventional renewable energy. Transmission operators have been criticized for a lack of credibility for neglecting the opinions of the public on the full environmental effects of proposed projects. In the case of APG, the alliance of sixteen Austrian environmental organizations ÖKOBÜRO question the actual need of the planned transmission development set in the Master Plan 2020. Environmental entities criticize the lack of transparency and information-sharing from APG in power grid planning and in turn, highlight the absence of critical evidence to support the initiated projects. Grid construction has direct and indirect impact on the surrounding ecosystem (electromagnetic field concerns, bird population and nature conservation issues).

**PPP in Transmission**

Despite transmission infrastructure being a key driver of economic growth and social livelihood, its actual development faces immense backlash and skepticism. The previously discussed challenges within the legal framework, investment mechanisms and environmental effects further prevent the success of realizing transmission infrastructure projects. Given that power infrastructure is primarily provided by the public sector, one may see an opportunity for private participation in enabling planned projects and resolving the respective challenges at hand. Public-Private Partnerships (PPPs) in transmission have been less common than in power generation, however their practice has been growing in number since the restructuring and liberalization of power markets. What is unique to transmission networks is its obligation for independent operation to ensure non-discriminatory access. As a consequence, even with greater private sector involvement these underlying principals must be upheld. Nevertheless, PPPs can be valuable in the financing, construction and operation of Greenfield infrastructure in the interest of gaining the transmission access fee revenue stream. Long-term concessions have been a widespread contractual structure in transmission. In this arrangement the financing, building and operation is outsourced to a private entity, which directly collects the ratepayer revenue for the service. However, alternative methods have arisen as viable options. A type of Greenfield deal structure is the Design-Build (DB) model that combines architectural/engineering work and construction under a fixed-fee contract. The public sector usually provides financing and operating/maintaining of the project. The Design-Build-Operate-Maintain (DBOM) structure

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adds operations and maintenance to the private entities’ task. This allows for better integration and coordination of design, operation and maintenance plans which in turn, provides an opportunity for increased efficiency and reduced cost. In Design-build-finance-operate (DBFO) arrangements the private sector contributes to the financing of the project. In this case, financing of a project will not be treated as government debt, reduce associated risk and resolve any issues relating to financial constraints and exceeding public resources.

The case study of APG’s transmission expansion efforts would benefit significantly from PPPs in project development. Having the private sector present in the initial design stage of a project can have several benefits. The intrusive and complex land requirement for transmission development demands all-inclusive and forward-looking project design. Integrating potential political, economic, social and environmental implications the expansion may have on its surrounding requires careful and intelligent decision-making. As a consequence, collaborating with private sector experts and taking advantage from wide-ranging knowledge may potentially reduce negative impacts. Currently with inefficient jurisdictions and long-lasting permitting procedures, greater focus and input from wide-ranging experts can provide a more encompassing view on the project (economic, social and environmental aspects) and may reduce the number of returning disputes. Nevertheless, this should not downplay the central requirement for a legal reform to simplify and improve project-permitting procedures. Moreover, with the need for private capital PPPs further enable greater focus on good governance in all aspects of project development. To attract outside funds and maintain competitiveness among bidders, the project has to preserve a certain level of transparency. In the case of APG’s expansion efforts, any efforts to demonstrate financial viability of the project would consequently resolve any project legitimacy and accountability questions. A dedicated project platform for improving information access and APG’s commitment to openly validate the project would improve public opinion and existing criticism. The proposed performance obligations set in the contract between both parties will determine quality, quantity and timing aspects that must be upheld and in turn, incentivizes reliable project delivery.

**Conclusion**

The current shift towards greater renewable energy deployment has revealed our system inefficiencies. The state of the transmission grid network is exhausted and if left unchanged will not enable an energy transition. The conditions in Austria are representative of the need for immediate action. The central geographic location requires Austria to have a reliable infrastructure to move clean energy resources to load centers and storage units. However, current difficulties in the legal framework, need for alternative finance measures and unanswered environmental questions cause for long delays and the incompletion of needed expansion projects. Most notably, the 380-V Salzburg line is a representative example of the difficulties at hand to develop a project and achieve reliability within the system. As a consequence, public-private partnerships (PPPs) may be a useful option to accelerate project development. Having

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greater cooperation and communication among public and private parties may provide the missing transparency, expertise and legitimacy to gain the support for projects of such an intrusive nature. Moreover, alternative private capital financing options and risk-sharing structure will not only safeguard operations but also economic conditions. PPPs are an opportunity to coordinate various stakeholder interests and help to efficiently and timely deliver the project. However, all significant prospects coming from PPP implementation may be undermined if the operational context remains unchanged. Efforts aiming at bolstering the legal framework are necessary to reduce the time required of the process itself and encourage investment to facilitate private sector participation. This fundamental structural challenge of the legal framework reveals that sole private participation will not narrow the infrastructure deficit. Only with a structural change that is committed to the transition and welcomes infrastructure buildup can public-private partnerships (PPPs) deliver efficient and timely projects.