ESIG/GPST September Webinar - Connect Faster: Improving Renewable Energy Integration With Modular Power Flow Control	
Question	**Answer**
How is PFC integrated into transmission planning processes?	Models are available for MPFC devices for all major planning software packages. Typically planners identify potential cases where PFC/MPFC may be beneficial and then apply the models to the relevant cases. Support is available from vendors and consultants for specialised cases or to automate studies to consider a wide range of scenarios. System planners utilize power flow control models to solve constraints for a variety of applications, including generation interconnection, reliability, uneconomic dispatch, and seasonal or maintenance and construction outages. These projects are evaluated according to the same standards applied to other transmission investment projects, meeting all requirements to ensure safe and reliable transmission system operation.
What incentives are required for GETS?	Improving the efficiency of the grid reduces costs for consumers, produces more just and reasonable rates, and, in the US, was specifically directed by Congress. The traditional regulatory reward system for utilities tends to focus business priorities on large capital projects, rather than low-cost high-impact technology deployments. The Shared Savings Incentive proposal for GETs submitted to FERC by WATT would align incentives for these investments in the public interest. Markets with performance-based transmission incentives, including the UK and Australia, have seen much wider adoption of GETs, and this model should be successful in the United States as well.
What are other potential GETs?	GETs are advanced transmission technologies that increase the capacity and efficiency of the existing grid. Dynamic line ratings, power flow control, voltage uprating and topology control are the leading commercial technologies available today. As additional technologies in this field are commercialized, the list of GETs will grow.

Slide 4 illustrates the damping impact of the grid on the volumes of renewables and hence CO2 reduction. Is there not pure commercial pressure to relieve this?	Significant political and commercial pressure is a driving force behind the focus on electric transmission in US infrastructure legislation and FERC action on transmission planning. Stakeholders as varied as labor unions and renewable energy advocates strongly support progress on rapid mitigation of grid constraints that are currently limiting generation buildout. Given the relatively stagnant utility regulatory structure of the past 100 years, process change and investment are seen as imperative to deliver the clean energy system of tomorrow.
Which grid codes are applicable for power electronics-based power flow control devices?	There is no single industry standard to reference for Smart Wires PFC. Therefore, the design was informed by a diversity of standards. Smart Wires ensures strict adherence to applicable international standards with a comprehensive design review process. A list of applicable standards can be provided to interested parties upon request.
Is participation in the ancillary services market competitive?	It varies by service, region and system. In some cases it is a regulated arrangement with set rates for provision and minimum technical standards required from generators. The general trend seems to be moving toward more competitive provisioning, which should increase the potential pool of suppliers, development of innovative solutions and overall efficiency.
How would you characterize the maturity of planning and operational tools and market engines to integrate GETs in a way that achieves projected benefits?	GETs like PFC have extensive model development history in nearly all transmission planning and protections software platforms. Some production cost software platforms have FACTS models that adequately capture most PFC features, while other platforms require workarounds. Utilities and system operators around the world have identified best practices for modeling GETs to ensure successful deployment and dispatch. There is a wide range of modelling support and training available from vendors and consultants.
Can you provide more details on how these power flow controllers work? E.g. is full power continually being processed and if so, what are the efficiencies?	PFC from Smart Wires uses power electronics to effectively increase or decrease the reactance of a given circuit, enabling real-time control of power flow. In general the operator will vary the amount of power flow control being used to meet real time system conditions. As the unit is based on power electronics, the unit's set-point can be changed frequently to actively manage power flows with no degradation in unit life. Additional details of device functionality can be provided upon request.

How much does PFC cost? Are there cost-benefit analyses that have general applicability? How are regulators being informed? Is it candidate for perf contract?	Typically, PFC projects can be delivered years faster and at a fraction of the cost of traditional transmission projects like new lines, rebuilds, and reconductors. They can also be easily increased or decreased in scale to reduce risk of stranding where the expected scenario does not materialize. Specific costs for projects can be provided under NDAs from most vendors. Performance contracts are an option but in most parts of the worlds the regulatory regimes would not support this structure.
How has PFC been successfully adopted and integrated by system operators?	System operators are obliged to evaluate transmission system investment proposals and familarize themselves with technical solutions to grid constraints. In regions around the world, including UK, Australia, Colombia, and the US, system operators have completed technical analysis to understand the value and controllability of MPFC and added the technology to their planning toolkits. Driven by real system needs, operators gain experience dispatching MPFC deployments under varying scenarios to address major system challenges.
Are there efforts in the industry to explore technologies that add partial controllability to lines instead of 100% controllability, which might not be needed?	PFC from Smart Wires are modular devices that provide partial controllability to the line on which they are installed. If more or less line controllability is required, the number of devices can be scaled accordingly to match the need.
How do phase shifting transformers compare to power electronics-based power flow control devices?	Once installed, PSTs cannot be moved or modified quickly enough to match the pace of change affecting the network, so they need to be either overrated compared to the initial requirement or replaced if the power flow over the network changes further, resulting in additional costs. PFC from Smart Wires is typically less expensive than a PST, with optimized deployments able to unlock more system capacity than traditional PST implementations. PFC provides more granular real-time controllability without degrading mechanical parts or impacting asset life. PFC are modular, scalable devices that can be easily redeployed, even leveraging a mobile configuration for rapid installation.
How do PFC implementations impact electricity markets?	PFC solve planning-horizon system constraints and provide operators with an enhanced toolset for optimizing system performance in real-time. To-date, the primary market impacts from these deployments have been from increased renewable generation deliverability and the associated reductions in system production cost.
For further information on slide 6 regarding tipping points:	https://www.ey.com/en_gl/digital/energycountdownclock
	https://www.ey.com/en_gl/power-utilities/as-the-countdown-to-a-new-energy-world-intensifies-who-will-beat-the-clock