PhysTEC 2021
Annual Evaluation Report

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About the Evaluation

Evaluation questions
The goals of the current PhysTEC project (from the proposal) are:

1. To engage a significant fraction of U.S. physics departments in developing programs to prepare greater numbers of highly qualified physics teachers
2. To test scalable levers for engaging physics departments in teacher preparation, and identify those which are most effective in different institutional contexts
3. To validate a model for thriving physics teacher preparation programs

In order to provide evaluation of these three goals, the current annual evaluation focuses on the following evaluation questions (from the evaluation plan):

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In 2020, the evaluation focused on Question #1. In 2021, the evaluation has focused on Questions #2 and #3.

Methods
This annual report provides an overview of evaluation activities and findings in the 2020-2021 grant year (Year 4). This report draws on the following data sources and evaluation reports.

Reports
- Regression Study of Graduation Rates (4/2021)
- PhysTEC 2021 Conference Evaluation (4/2021)
- CSU PhysTEC Regional Network Conference Evaluation (2/2021)
- Funded Site Graduation Evaluation (updated 12/2020)
- Targeted site sustainability evaluation (12/2020)
- State of the PTEPA (8/2020)
- Recruiting site sustainability evaluation (2/2021)

Other tools:
- PhysTEC State Networks Dashboards: Google Sheets for organizing information across two new state networks.

This report provides a synthesis and recommendations across these areas of feedback.
Synthesis

Evaluation Question #1: To what extent are PhysTEC activities effective levers of change?

Evaluative response:

The Physics Teacher Education Program Analysis (PTEPA) Rubric ratings have demonstrated program strength at PhysTEC-supported institutions, with Comprehensive sites achieving exemplary program structures after just one year. Ratings in Leadership and Collaboration are particularly strong and are also known to be associated with the ultimate goal of increasing the number of future physics teachers. Additionally, a graduation rate analysis (see below, Evaluation Question #2) found that legacy sites contributed substantially to increasing physics graduation rates at supported sites, and that this effect is attributable to funding (rather than to background variables). Thus, I conclude that these activities are substantially effective levers of change in addressing the national physics teacher shortage, and that it is appropriate to offer these varied levels of engagement. I also recommend more explicitly supporting smaller and Bachelor’s-granting institutions.

In both online conferences offered this year (PhysTEC, and the SoCal network) the activities were important levers of change in enabling broad participation, exchange of information and ideas, and networking. Many formerly funded PhysTEC sites name the conference as influential. Thus, I conclude that these conferences were very effective levers for change.

These findings draw from the following reports:
- State of the PTEPA Report (8/2020)
- PhysTEC 2021 Conference Evaluation (4/2021)
- CSU PhysTEC Regional Network Conference Evaluation (2/2021)

PTEPA Rubric Ratings

The Physics Teacher Education Program Analysis (PTEPA) Rubric has been developed to document the practices and structures of physics teacher education programs, enabling self-improvement as well as contributing to generalized knowledge about teacher education. As of August 2020, we had rubric data from a total of 32 sites, enabling examination of trends of rubric results. The rubric has 3 levels (Developing, Benchmark, Exemplary), with “Benchmark” representing the desired level. It was developed based on results from 8 “thriving” physics teacher education programs with exemplary teacher graduation rates.

- **New Comprehensive sites show great program strength, becoming aligned with thriving program results after just one year.** New Comprehensive sites show greater rubric strength than most other types of sites (except Thriving), demonstrating both selection effects (Year 0) and growth (Year 1). During the course of Year 1 of funding, current Comprehensive sites demonstrate growth across many areas of the rubric, with rubric ratings which now rival those of the Thriving Programs except in areas of Program Assessment.
• **Some rubric ratings are predictive of teacher graduation rates.** High ratings on Standard 2 ("Leadership and Collaboration") are related to high teacher graduation rates. High ratings on Component 3B ("Recruitment Activities") are related to higher teacher graduation rates. However, this relationship disappears when degree type (Ph.D.-granting or not) is taken into account.

• **Comprehensive sites show program strength in key areas for physics teacher education.** Thriving programs and Comprehensive sites are particularly strong in Standards 1 ("Institutional Commitment"), 2 ("Leadership and Collaboration"), and 5 ("Mentoring"). Standard 2 has been demonstrated to be related to graduation rates.

• **More mature sites show greater program strength than newer sites.** More mature sites (Targeted and Recruiting legacy sites) typically show greater strength than newer sites (recent Fellows and current Recruiting sites). This demonstrates the impact of engagement with PhysTEC over time. It also suggests that sites with lower funding levels may achieve stronger program results over time, approaching those of those funded at higher levels.
PhysTEC 2021 conference
The inaugural online PhysTEC conference was received very positively. It mainly drew the typical attendees of PhysTEC conferences, rather than new participants. Many participants noted that having the conference online removed barriers to their participation, even apart from the pandemic. There is a benefit to offering the conference online, as well as in-person.

- **Attendance at the inaugural online PhysTEC conference was similar** to previous in-person conferences; over half of the 119 registrants attended. Most of these attended “most” or the “full” conference, but 30% attended half (or less) of the conference.

- **The virtual format did not seem to draw new attendees:** only 10% were first-time attendees (compared to 30-40% in previous years). Most attendees (60%) were at formerly or currently funded sites, and attendees were split among primarily undergraduate (30%), master’s granting (21%) and PhD-granting (43%) institutions.

- **Participants’ experience with the online conference was very positive.** They were highly satisfied with the technical quality, and the content. Almost all (93%) indicated that they gained knowledge about physics teacher preparation that was worth the time of their attendance – and newcomers, and those at non-PhD-granting institutions felt more strongly about the value of the conference. Many specifically commented that they were surprised at how well the online format worked. People indicated learning that ranged from concrete to philosophical and named many concrete plans that arose from their attendance. While only a few teachers or TIRs responded to the survey, they overwhelmingly felt that the conference was deeply relevant.

- **There is a clear benefit to offering the conference online.** About two-thirds indicated that cost and/or time to travel had been a barrier to attendance in the past (though only one of these were attending for the first time). Most indicated that they would attend this conference online again. Most would prefer the in-person conference in the future if offered a choice, but several were very interested in online options. A minority indicated that they would only attend the conference if it were online in the future or that online offerings would increase the frequency of their attendance. However, open-ended responses showed a clear interest in having online options available.

- **There was a clear consensus that in-person conferences allow for better networking and informal, emergent connections.** Online conferences were seen as
more convenient and cost-effective, which may tip the scales towards attendance for some, depending on what is going on in their personal and professional lives.

- **Several differences were apparent between those at PhD-granting institutions and those at other institutions:** Those at PhD-granting institutions were less likely to attend the full conference, were more likely to have attended many previous conferences, and were less likely to indicate that they hadn’t been able to attend previous conferences due to cost or time to travel, and did not agree as strongly that the learning was worth the time of attendance. These findings seem to reflect the greater resources at PhD-granting institutions, and less value placed on the opportunity to attend the virtual conference for low cost. Thus, online conferences may be particularly beneficial for under-resourced primarily undergraduate institutions and regional publics.

- **In a table discussion, participants made the following requests of PhysTEC:** (1) Provide more explicit support and guidance for Bachelor’s granting institutions, especially given their state of threat and contribution to teacher education. (2) Provide a 5+ club for smaller institutions (e.g. 2+ club) based on institution size. (3) Provide mini-grants on an annual basis to support ongoing activities.

**CSU PhysTEC Regional Network Conference**
The CSU PhysTEC Regional Network Conference took place online on January 29, 2021. About 70 people attended. Overall, the conference was a great success, leading to the types of information sharing, networking, and engagement that was hoped for. Perhaps even more importantly, the conference demonstrated the value of the regional network, and the benefit of engaging across campuses. This is momentum which can be built upon.

- **People appreciated the ability to network,** talk to colleagues, learn what other campuses are doing, and get ideas. In particular the opportunity to interact with others and share ideas was highly valued, which is remarkable for an online conference.

- **About one-third indicated that they had not interacted with physics and/or education faculty** involved in physics teacher preparation on other campuses, but several became aware of these people for the first time and/or had plans to interact with them after the conference.

- **Almost all respondents had concrete plans** to implement post-conference. About half (N=15) indicated a plan to try something related to recruitment.

- **There is evidence that learning occurred during this short conference.** While most people already knew of many national programs (Noyce, LA Programs, PhysTEC, MSTI, GFO), about 15-20% of respondents learned about these for the first time.

- **Those who had not previously engaged in the network benefited even more.** These individuals showed some different patterns of responses which demonstrate the value of opening the conference to a wide audience; they demonstrated greater learning gains about programs and teacher education.

- **Several suggestions were made for next-steps for the network.** Another annual conference was the highest priority, but informal discussions and webinars were also highly prioritized. Some topics for webinars were suggested.
Evaluation Question #2: To what extent are PhysTEC activities scalable levers of change?

**Evaluative response:**

In analysis of graduation rates, I find that PhysTEC funding results in substantial long-term increases in teacher graduation rates, and that this increase is greater and more consistent for the more substantively funded Comprehensive sites. Additionally, whether a site is a Comprehensive site is a strong predictor of post-funding teacher graduation rates, and whether a site experiences a pre-post funding change in graduation rates – outstripping the effects of all other variables such as historic teacher graduation rates, department size and highest degree granted. Thus, continuing to offer grants is important for scaling-up the effective levers of change that PhysTEC has established to more institutions.

The small grants, however, are cost-effective; while they are less consistent in increasing the number of teachers they graduate, and they experience smaller gains in graduation rates, the cost per year of teaching from those graduates is more modest than the Comprehensive sites. There is also less money at risk for any decision to fund a site. Thus, I suggest that offering a wide range of grant opportunities is a very important part of a balanced funding portfolio, and thus of offering scalable levers of change. The wide range of funding opportunities allows cost-effective outreach to a variety of institutions and departments (“scaling out”). As noted above, however, I do suggest making sure to scale out to Bachelor’s granting and smaller institutions more explicitly.

These findings draw from the following reports:

- Funded Site Graduation Evaluation (updated 12/2020)
- Regression Study of Graduation Rates (4/2021)

**Funded site graduation**

This study used physics teacher graduation data available from formerly funded (“legacy”) PhysTEC sites to explore graduation rates over time, and by funding track. A total of N=43 sites since 1998 were included (26 Comprehensive, 8 Targeted, 9 Recruiting). Comprehensive sites were funded at $300,000 level, Targeted at $75,000 level, and Recruiting at $30,000 level, for 3 years. Sustainability data is reported below under Evaluation Question #3. Graduation rates were compared pre-funding, during funding plus 1-year post-funding (“funding +1”) to account for lagging indicators, and post-funding.

- PhysTEC funding is associated with significant gains in graduation rates during funding, and most sites experience gains, across all tracks. The average gain in physics teacher graduates was nearly one graduate (+0.9 graduates); this gain is statistically significant (p<0.001).
• The number of teachers graduated prior to PhysTEC funding has a strong influence on the numbers, and gain, during PhysTEC. The more teachers that a site graduates prior to PhysTEC funding, the more graduates it is likely to have during funding, but the lower the gain in teacher graduation numbers (“ceiling effect”).

• Department size is not a strong influencer of physics teacher graduation rates. No matter how the effect of department size was tested, it had no influence on graduation or change in graduation rates.

• Comprehensive sites generate greater gains during funding than other funding tracks, but all funding tracks demonstrate success. Comprehensive sites experience greater gains in numbers of teacher graduates (+1.1 graduates), and a greater fraction of sites experience gains (76%) than other funding tracks, and the increase for those sites with gains is greater for Comprehensive sites (+1.7 graduates) than for other types of sites (+1.1 graduates). However, all funding tracks experience positive gains from pre-to-during funding, and more than half of all sites experience positive gains.

• Most Comprehensive grants (72%) show net long-term gains in graduation rates. Gains were +1 teacher on average but almost +2 teachers among those with net long-term gains. Long-term impacts are mixed for other types of grants. See Evaluation Question #3, below, for more detail.

• Smaller grants may be more cost-efficient, and less risky investments

While Comprehensive grants provide more robust results, the increased cost of these grants results in a cost per year of teaching that is about 3 times that of the Recruiting grants ($5400 vs. $1600). Targeted grants had a higher cost, but similar rates of success as Recruiting grants in the current analysis, resulting in a cost-benefit ratio that is less favorable than Recruiting grants (cost per year of teaching is $4700; similar to the the Comprehensive grants), demonstrating the importance of grant cost, long-term gains in graduation rates, and percent of sites with gains, in cost-benefit analysis. The investment risk factor of the larger grants is also increased: based on the percent of grants which do not result in annual graduation increases, for each funding decision about $186,000 is at stake for Comprehensive grants (compared to $128,000 for Targeted and $69,000 for Recruiting grants). Important caveat: These cost/benefit calculations do not include less tangible benefits (e.g. increased site capacity and infrastructure), which are also important.

On the next page is a visual one-pager which summarizes these results.
Graduation rates increase on average across all sites

 Increases during funding

+0.9 average increase in number of physics teacher graduates* (p<0.001).

70% of sites increased the number of physics teacher graduates during funded period

+1.5 average increase in graduates at those sites with gains (p<0.001)

Long-term increases post funding

+0.7 average increase in number of physics teacher graduates long-term pre-to-post (p<0.001)

59% of sites increased the number of physics teacher graduates long-term pre-to-post funding

+1.8 average increase in graduates at those sites with gains (p<0.001)

*Strongly limited by pre-funding graduation rates, but not related to department size

More gains for Comprehensives

Robust long-term increases for Comprehensives

+1 Total increase in graduates from pre-to-post funding at Comprehensive sites.

72% of Comprehensive sites increased the number of physics teacher graduates vs. ~30% at others

+1.8 average increase in graduates at Comp. sites with gains (p<0.001) vs. ~1.5 at others

But smaller grants cost efficient

25% Reduced cost per year of teaching, and reduced investment risk.

Methods

Analyses completed with “Funding +1” period which includes funded period plus one year post-funding, to account for lagging indicators. Graduates are rounded to nearest whole graduate. See full report.

Sites included were all N=43 sites funded since 1998 (26 Comprehensive, 8 Targeted, 9 Recruiting). In analyses addressing the sustainability of the grants, these were reduced to include only those with information in the sustainability period (N=25, 8, and 7 respectively).
Regression study of graduation

The purpose of this study was to present statistical findings from data collected from 43 PhysTEC Legacy Sites teacher graduation rates, exploring possible contributing variables to teacher graduation outcomes. Funding tracks included Comprehensive, Targeted, and Recruiting sites; only a few years of post-funding data is available for Recruiting sites. An initial analysis was completed in 2019 by Joseph Taylor, and then a more recent analysis in 2021 by Remy Dou used updated data and variable definitions. The questions explored were what factors predict (1) whether a site experiences a change in teacher graduates during or post funding, (2) the size of that change, and (3) the absolute number of graduates during or post funding. Results include:

1. **The average number of teacher graduates pre-funding is the strongest predictor of graduation rates during funding.** This variable explains 45% of the variance in during-funding graduation rates during the 3 funded years; for every one standard deviation increase in the average graduates pre-funding, one could expect a 0.54 standard deviation in the average number of teacher graduates during funding.

2. **However, whether a site is a Comprehensive site is the strongest predictor of post-funding graduation rates.** This finding suggests that Comprehensive funding is associated with more sustainable increases in teacher graduation rates. This effect remains even when pre-funding teacher graduation rates are included.

3. **Whether a site is a Comprehensive site is also the strongest predictor of whether there is a change in teacher graduation rates pre/post.** There is a 98% probability that a Comprehensive site will exhibit an increase of 0.50 or more teacher graduates from pre-funding to post-funding. No other factors were significant.

4. **Department size and highest degree granted are not significant predictors of teacher graduation rates.** These factors did not play into any of the regression models, including department size, change in department size, whether department size changed, or several variations on the highest degree granted (categorical or binary).

5. **Change in teacher graduation rates** is not an outcome that can be statistically tested using regression models with this data.
Evaluation Question #3: Are funded site outcomes and activities sustained over time?

**Evaluative response:**
Based on long-term impacts of funding on graduation rates at a variety of institutions, I find that outcomes and activities are somewhat sustained over time. Comprehensive sites are most consistent in maintaining gains in graduation rates, but other funding tracks experience long-term gains at almost half of the sites. High-performing sites contribute even more to net long-term gains in graduation rates. Apart from graduation rates, however, both Targeted and Recruiting sites mentioned a wide variety of strengths in institutional commitment, recruitment activities, leadership capacity, physics teacher program structures, and early teaching experiences (i.e. PTEPA Rubric standards 1-3). Sustainability of other elements depended on the site’s focus, but structural elements (e.g. licensure pathway, courses, LA programs, advising) and cultural elements (e.g. positive perceptions of teaching in the department) were typically maintained. One of the most positive impacts is often the departmental culture of teaching and learning. TIRs were typically not maintained. A sustainability study of Comprehensive sites is currently underway. Thus, I conclude that funding builds capacity, and that many activities are sustained over time, but that this capacity is inconsistently reflected in actual graduation rates. For greater sustainability I suggest stretching out site engagement over a longer period of time.

These findings draw from the following reports:
- Funded Site Graduation Evaluation (updated 12/2020)
- Targeted site sustainability evaluation (12/2020)
- Recruiting site sustainability evaluation (2/2021)

**Graduation rates**
Here I report on sustainability information from the funded site graduation study, and the regression study, both described above in Evaluation Question #2.

- **About half of the Comprehensive sites sustain their gains and 72% show long-term gains in graduation rates.** Among those sites which experienced gains in graduation rates, 40% of Comprehensive sites maintained the gains achieved during the funding period after funding ended. However, 72% experienced net long-term gains in graduation rates compared to their pre-funding rates (because even a decrease in graduation rate during-to-post-funding still represented an overall improvement compared to pre-funding).

- **Net increases are +1 teacher on average, but almost +2 teachers among high performing Comprehensive sites.** On average, Comprehensive sites increase their graduates by +1.0 graduates from the pre-funding to the sustainability period, and this gain increases to +1.7 graduates when we only include the 72% which experienced long term gains.

- **Net long-term impacts are mixed for other types of grants.** The net long-term impacts are closer to 0 graduates for smaller grants and only few of the other types of sites maintained gains made during the funding period. A few Targeted and Recruiting grants do demonstrate net long-term impacts on graduation rates, resulting in potentially cost-effective interventions (gains of +1.3 and +1.8 graduate among those with longer-
term gains at Targeted and Recruiting, respectively), though at least a few of these might be due to floor effects. Across all grants, these results have the potential to address the national teacher shortage.

**Targeted site sustainability**

This study investigated durable outcomes from the 8 Targeted Sites awarded in 2010 through 2013. Graduation rates were analyzed from 8 sites through 2019, and 6 participated in interviews and PTEPA data collection in June 2019. The evaluation found that sustainability was mixed; the relatively high cost of the grants ($75,000) hampered cost-effectiveness but lowering this cost would result in a cost-effective program, much like the Recruiting grants. Sites experienced a variety of capacity-building impacts.

- **Targeted sites increased graduation rates during funding.** Targeted sites increased their annual physics teacher graduation rates by +0.6 teachers on average from pre-to-during funding, with 5 sites (63%) experiencing increases.

- **Sustainability of these graduation gains is mixed.** Investigating the sites which experienced positive gains during funding (N=5), only 2 (Central Washington and SUNY Geneseo) were found to maintain that gain.

- **Net long-term graduation gain only occurs for some sites.** Regardless of whether gains made during funding were fully maintained, we can also investigate whether there
is an overall net increase in graduation rates from pre-to-post funding. On average, there is only a total net gain of +0.2 teachers pre-to-post, which is indistinguishable from zero. Considering only those sites that experienced a net increase in graduation numbers pre-to-post (N=3; 57%), the net increase in graduation rates was +1.3 teachers. For these 3 sites this is a valuable result and has potential to address the national teacher shortage. However, this also means that the Targeted grants were only somewhat cost effective; they cost only a little less than the Comprehensive sites per teacher-year.

- **The three sites with strongest graduation rates stood out in their capacity and activities.** These sites had strong ratings on the PTEPA, considerable strength in Institutional Commitment (including Rewards for physics teacher education), Recruitment, and Assessment. The time to degree for teacher candidates was streamlined. They exist within strong physics programs held up as national models. They also have strong and engaged champions of teacher education in the physics department.

- **Program structures and capacity at all sites were improved as a result of the Targeted grants.** As measured by the PTEPA the most sustainable improvements were made in Recruiting, with some improvements in Early Teaching Experiences (primarily LA programs) and Recruiting Activities. Program leader capacity was mentioned frequently as improved, including a shift in identity and values for leaders. The conference was a critical part of this shift. Another strong theme in interviews was that the overall culture of teaching and learning in their department was supported by engaging with PhysTEC. Teachers in Residence (TIRs) were not typically sustained.

- **LA programs appear to be “touchstone” interventions with many ripple effects within the institution.** Many Targeted sites also reported the creation or strengthening of LA programs. Leaders noted that a focus on LA programs was beneficial because it strengthens the capacity of leaders, generates collaboration within and outside the department, organizational learning, and ultimately enhances the teaching culture of the department. In this way, an LA program or other introductory course reforms might be considered a “touchstone” intervention with a ripple-effect that enhances many elements of a program in ways that can enhance teacher preparation, even if indirectly. I suggest that there might be other such “touchstone” interventions that are appropriate for different institutions. This is a finding that mirrors those of Foote and Knaub (2018) and Scherr et al. (2014) showing that PhysTEC activities that fit within the routines and value system of the department are more likely to be sustained. The lack of sustainability of Teachers in Residence at Targeted sites is likely because it has not been framed in a way to fit inside normal departmental responsibilities.

![Favorable ratings (Average across sites)](image-url)
Recruiting site graduation
This report investigated outcomes from the 7 of the 9 Recruiting sites funded from 2014-2017. The award amount of these recruiting grants was $30,000, funding period was 3 years, and the support offered included an annual video call, the PhysTEC conference, and a dedicated meeting at the conference. Recruiting sites are primarily undergraduate institutions, graduating 11 physics majors per year on average. The evaluation found that the grants resulted in small gains in teacher graduates, but that this gain was cost effective due to the low cost of the grant and the fact that all sites experienced positive impacts (even if graduation rates did not increase).

- **There was a small increase in graduation rates, on average.** About half (N=4 out of 7) experienced increases in graduation rates during funding (+1.1 teachers/year on average). Due to post-funding drops in graduation rates, N=2 experienced net increases in graduation rates pre-post funding (+1.8 teachers/year on average), a programmatically significant increase. Across all sites, the average increase in graduates pre-post funding was +0.4 teachers.

- **Recruiting grants are particularly cost-effective.** Because of the low cost of the grants, even this small gain in teacher-years results in a cost-effective program of $1664 per year of teaching for Recruitment grants. Enhancing the numbers of sites experiencing positive gains would further enhance cost effectiveness.

- **All sites experienced tangible benefit from the grant** regardless of enhancement of graduation rates. Durable impacts included prestige and recognition for physics teacher education, degree pathways, and active recruitment efforts. All sites indicated that PhysTEC positively impacted physics teacher education at their institution; on average they rated the impact as 80 (out of 100). They also indicated that engaging in PhysTEC is likely to lead to further future improvements, though less strongly so (average rating 65).

- **Recruiting activities and structural supports were named as the most critical steps to success.** The most common support that leaders indicated led to increasing the number of physics teacher graduates were recruiting activities (brochures, program publicity and branding, visiting classrooms to pitch the program) and structural supports (Education waiving prerequisites, additional funding). No site listed a TIR among the most important steps, though a few felt it was an important part of the program.

- **Enhancing graduation rates was often hampered by small numbers of majors, or poor perceptions of teaching as a profession, or state licensure issues.** Using Get the Facts Out, and engaging in program-building activities, may help such sites. Those with small numbers of majors may also benefit from combining forces with other STEM departments. More productive grants were less hampered by these difficulties. More productive grants did not seem to be typified by more active or engaged champions, or stronger collaborations with Education.

- **Sites with the greatest graduation gains were typified by a climate which supports teaching.** Their activities also seemed to include particularly concrete, well-defined early
teaching experiences which were sustained: Recruiting students to be paid planetarium presenters, encouraging students to take Methods course, and giving students stipends to engage in Step 1 courses.

- **Structural and cultural elements of the program were typically sustained**, including a supportive culture in the institution or department (all sites), the program team (all sites), collaboration with education (all but 1 site), recruitment activities (all sites) and licensing pathways (all 3 sites which made changes); all in PTEPA Rubric Standards 1-3. Program assessment was not commonly maintained, and few changes were made to rewards or recognition, coursework, or community building.

- **Sites expressed appreciation to PhysTEC for this work**, which they felt was important. They requested that PhysTEC create a short video about teaching (which is currently a project of Get the Facts Out), that they encourage collaboration between physics and education, that they financially support TIRs and early career teachers, and that they support state advocacy to support more reasonable licensing criteria.
Recommendations

Below are selected recommendations that are particularly salient for project directions.

**Continue to offer a range of funding tracks, including more small grants.**
PhysTEC funding has a strong influence, and these attract a variety of institution types. Small grants are a good investment in terms of the cost per graduate and low risk. Comprehensive grants also have a very strong track record, and contribute to long-term graduation increases. One could also consider funding Comprehensive sites at a lower level to enable more widespread funding. Offering smaller grants at amounts lower than the Targeted grants (which was $75,000 over 3 years) would result in a cost-effective intervention. For these smaller grants, site selection should probably include an assessment of whether there is capacity to enhance the strength of Standards 1 and 2 (Institutional Commitment / Leadership and Collaboration) but I don’t believe it would be prudent to only select sites that already have this strength.

**Provide explicit support for primarily undergraduate and smaller institutions.**
Offer programs (within the conference, and the project as a whole) aimed at these institutions. Create a version of the 5+ club aimed at smaller institutions based on institutional size. For smaller institutions exceptional performance was found to be graduation of 2-3 teachers/year (or gains of 1-2 teachers/year).

**Offer grants for longer time periods and with opportunity for long-term engagement.**
It takes time to establish changes in culture and capacity (Standard 1 and 2), and an additional year of funding (or partial funding) could help establish these structures more firmly and perhaps increase the number of sites with sustained gains. Given the strong impact of the conference on maintaining and enhancing leader identity and capacity, I believe it is imperative that legacy site leaders be able to attend one conference every 2-3 years without cost, perhaps through an application process. Access to travel funds is particularly important for smaller institutions such as Recruiting and Targeted sites. Virtual site visits for legacy sites would also be impactful. Mini-grants (below) are another way to maintain engagement.

**Identify states with unfavorable licensing requirements and focus effort there.**
Many sites report challenges related to licensure requirements, and request assistance in advocacy to change those requirements. This might be a more effective near-term intervention in such states than recruiting future teachers.

**Continue to focus efforts on Get the Facts Out.**
Poor perceptions of teaching is named as a barrier to sustainable gains for many sites, and the recruiting activities offered by the GFO project are aligned with the types of activities which are both impactful and sustained at legacy sites.

**Suggest sites focus their activity on a single key intervention with “ripple effects” for department climate for physics teacher education.**
Encourage sites to develop concrete, well-defined recruitment activities which can sustain, and to seek structural supports (e.g. agreements with Education, future funding). LA Programs were impactful because they strengthened champions’ capacity to lead change, enhanced collaboration with Education, and had impacts that the department faculty cared about (i.e. undergraduate success). LA Programs are not the only interventions which can achieve these goals. For a small grant, and smaller site team, choosing a focused activity that hits several
goals in one, while building departmental engagement, is reasonable. Sites may need some assistance in choosing these activities, perhaps in the format of pre-proposal “coaching” (which has been done in the past) or discussions.

**Provide annual mini grants of $1000-5000.**
These mini grants would be a valuable way to continue to spark activity at institutions in an ongoing fashion. They suggested an annual RFP for $1000-5000, in early Fall, with a short application, requiring the use of PhysTEC resources, and a simple report. Uses of such mini-grants would include an RET opportunity for a pre-service teacher, supporting a TAG group, buying some equipment, stipends for mentor teachers, and gatherings between in-service and pre-service teachers.

**Offer the PhysTEC conference online on an ongoing basis.**
My personal recommendation is to provide it online every other year and offer all plenaries online during in-person conferences. This can maintain engagement to a broad audience, including teachers and under-resourced institutions (especially PUIs). However, those online conferences **need to be advertised differently to draw newcomers.** One particularly ripe audience are those with a new teaching track in the department: Is there any way to identify such people? Do not permanently replace the conference with an online version however; many irreplaceable benefits were cited for the in-person version.

**Ensure that regional networks offer regular opportunities in-person and online.**
Based on the success of the CSU Southern California event, I suggested having a follow-up event within a month to maintain momentum, creating a mixture of informal discussions and webinars aimed at sharing information and generating discussion, involving K12 teachers in the network, and creating a clear online presence. I also suggested hosting the conference again next year. These recommendations are relevant to all networks.

**Project responses**

Project responses to this evaluation report will be submitted along with the NSF annual report. The PhysTEC project has shown exemplary commitment to incorporating feedback from the evaluation and has also submitted written responses to each evaluation report cited in this report at the time that the report was provided (with the exception of two more recent reports). A few select project responses from those written responses include:

1. We are already strongly favoring continuing Recruiting Grants or similar small-funding programs, and will seriously consider all of your recommendations when designing that program. We will think about ensuring a longer duration (3-4 years) in order to maximize impact.

2. We are already in the practice of (and plan to continue) supporting the use of GFO resources and screening grant applicants for low numbers of majors and poor climate or collaboration. For the latter, we may indeed recommend an LA program and/or EP3 guide for those with weaker departments to aid them in becoming stronger candidates for a recruiting grant.

3. We will track sites’ teacher recruitment early in their grant and take appropriate action, and we will encourage the development of concrete recruitment activities.

4. Identifying states with unfavorable licensing requirements is something we will need to look into. One way to start may be to ask a few key PhysTEC community members if they think we should survey our members about it, or if there is another way.

5. We now know that virtual site visits and virtual conferences can be successful and see these as potential ways to engage more sites for less money.

6. Recommending that sites focus on such a key intervention (at least to begin with) is an excellent idea and one that we will add to our pre-grant coaching and perhaps to future RFPs.