

# **Higher Education in Regional and City Development: Sonora, Mexico**

## Assessment and recommendations

### *Sonora – climbing the ladder of inclusive and sustainable development*

Sonora is among Mexico's wealthier states with a GDP per capita about 15% higher than the Mexican average. Strategically situated next to the US markets and fuelled by foreign direct investment (FDI), Sonora's GDP growth generally outpaces the rest of the country, with a growth of 7% in 2011. Sonora's economy is more diversified than those of other Mexican states, with important sectors in agriculture, mining, animal husbandry, fisheries and tourism, as well as a large, diverse and growing manufacturing base. New emerging industries include software development, supply chain management and logistics, and medical tourism. All of these sectors require distinctive educational strategies that combine theory and practice.

After a period of stagnation produced by competition with China for FDI and a recession-induced slump, the FDI-based *maquila* sectors are once again growing throughout Sonora, with new business locations and increasing employment. A significant part of Sonora's public resources has been committed to meeting their demands, including the demand for a trained workforce. The FDI-driven expansion of jobs and production in Sonora attracts migrants from other states, who also find jobs in the growing service and construction sectors and require skills upgrading.

While Sonora, like other northern states, is wealthier than southern Mexico, a significant portion of its population that is now close to 2.7 million faces poverty, severe income inequality and limited access to education and jobs in the formal labour market. The spatial distribution of the population contributes to patterns of unequal access to services, including tertiary education, which particularly affects the rural population. Given Sonora's high level of poverty, relatively modest income performance and unemployment rate above the national average, the state is facing the need to improve its economic profile and move up the competitiveness ladder.

Sonora's outward development model has served the region well, but now faces many challenges. If Sonora wants to move up the competitiveness ladder it needs to have a highly skilled population and knowledge-based economy that can absorb these skills. Therefore, the ability to fuel local

growth by cultivating relevant skills is the best guarantee that Sonora will thrive in future. Sonora's tertiary education system can play an important role in transforming the regional economy and society, but its full potential has not yet been mobilised for regional and local development. In this context, the key challenges for Sonora, its universities and other tertiary education institutions are:

- How to raise the overall education attainment levels and ensure that education provision is aligned with the long-term needs of Sonora's economy and population? How to improve the flexibility of the workforce to adapt to the changes in the global economy and to guarantee inclusiveness in education and the labour market?
- How to promote new business formation, indigenous innovation and the development of local industry? How to ensure that local firms are linked to the global value chains and that the region fully benefits from knowledge and technological spill-overs?
- How to address the problems of poverty, social inequality and environmental needs of the population?

To address these challenges, Sonora needs joint efforts in regional development, including a human capital, skills and innovation strategy with a vision, measurable goals, milestones, co-ordination measures and a robust evidence base. Tertiary education provision and research, development and innovation efforts need to be better aligned with Sonora's long-term needs by building stronger links between institutions and existing and emerging local industries. Joint efforts are needed to continue to raise the educational level of all, to strengthen skills for new and changing jobs and to focus on Lifelong Learning. Pathways between the technical education sector and universities need to be strengthened. To move up in the ladder, Sonora needs to strengthen its research trajectory and foster its contribution to Mexico's technological output. RDI in local SMEs and new business formation should be promoted, while transfer from informal to formal economy should be facilitated. Complementarities in economic and social goals for sustainable development should be pursued.

## Human capital and skills development

*Sonora has made great strides in building its human capital and skills and is today one of Mexico's top three states for highly educated young adults. One-third of Sonora's young adults have tertiary education qualifications. This progress is founded on Mexico's highest rates in literacy and upper-secondary school completion. It has also been based on tertiary education expansion and diversification driven by the increasing demand from industry and families that see the value of and invest in education.*

Sonora's has the highest share of tertiary educated workforce in Mexico after the Federal District. In 2010, 30% of Sonora's young working age adults (25-34 years) had tertiary education qualifications, compared to 15% of the 55-64 year-olds, showing rapid progress in educating Sonora's population, far above the national average (24% and 15% respectively). Sonora's tertiary education enrolment rate has grown to 37%, reaching over 100 200 students in 2011-2012. These achievements have been built on the improvements made in earlier levels of education. At 95%, Sonora's literacy rate is the highest among Mexican states. Altogether, 96% of children aged 6-14 are attending school in Sonora. At 75%, Sonora's upper-secondary school completion rate is the best among Mexican states. One in three secondary school graduates in Sonora continue their studies in tertiary education, compared with one in four in Mexico. The expanding tertiary education sector serves the needs of the Sonora's young population: half of the regional population is 25 years or younger and 29% are under the age of 15.

The approach taken by the state of Sonora in order to broaden and deepen the impact of TEIs in the region has emphasised diversification of institutions and decentralisation of technical education opportunities throughout the state, including in historically under-served rural areas. Diversification also applies to subject matter, which now includes more applied scientific and technical programmes. Driven by continuing industrial demand for skills, the technological education sector has played a major role in widening participation. The state government-driven "common space" (*Espacio comun*) for technological institutions is a potentially strong tool for enhancing mobility and collaboration across the sector, but the implementation process has been very slow. These institutes have some degree of flexibility in the composition of their programmes, which allows

them to serve the needs of the local population not only in bigger cities but also in rural and indigenous communities. The expansion of tertiary education has also been driven by growing levels of wealth and the ability of Sonora's families to invest in education, while Sonora's Student Loan Institute (*Instituto de Credito del Estado de Sonora, ICEES*) puts the state as a leader in Mexico in providing assistance to needy students.

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*Sonora has built a significant comparative advantage by developing skilled labour for the foreign companies investing and building plants in the state. Yet narrow skills development will not serve Sonora's economy and population in the long run. Continuing efforts are needed to raise the overall education levels and general competencies that will allow people to adjust to rapid changes in the labour market and equip them with the capacity for lifelong learning.*

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The state of Sonora offers significant incentives to the *maquila* industries, or foreign companies investing and building plants in the state, including subsidies for workers' wages during the initial phase of employment, support for job training and custom-designed workforce assistance. This strategy has helped identify Sonora as a source of skilled labour available at approximately one-third the cost of similarly skilled labour in the United States and as a place where the public sector takes responsibility for the initial workforce preparation for industry. Although the *maquila* sector has an image of low-tech, routine manufacturing, the majority of FDI employers (57%) require workers with technical skills. The state of Sonora's technical expertise, especially in engineering, is attracting companies requiring higher value added skills. This workforce is particularly evident in the supply chains in aerospace and electronics in the Guaymas and Empalme industrial parks, and in the Hermosillo production complex built around Ford Motor company production.

While the focus on custom-designed workforce training is commendable, overly narrow skills development will not serve Sonora's population and economy in the long run. Despite significant progress, Sonora's overall educational attainment levels remain low by OECD standards and concentrated in few municipalities due to differentiated access to educational opportunities by age, skill and socio-economic background, and a continued bifurcation in educational attainment, with a large portion of the state population having only completed primary school education. According to PISA (Programme for International Students Assessment), the

learning outcomes of Mexican students are generally low and in Sonora they are even lower than national averages, which implies a problem with the quality of education. Due to school failure in Sonora, a large number of youth are outside of the labour market, education and training: around 33 000 12-29 year-olds neither study, nor work in Sonora. Sonora's unemployment levels (5.56%) are higher than the national average, whereas activity rates in the informal economy are close to the national average (13.5%).

Continuing emphasis needs to be placed on raising the overall education levels and general competencies that will allow Sonora's population to adjust to rapid changes in the labour market and have the capacity for lifelong learning. Long-term, comprehensive, multi-stakeholder efforts to enhance the quality of education could improve the completion and learning outcomes at schools and the preparation of both the youth and adult population for further education. Lifelong learning strategies should go beyond the current efforts that focus on the provision of direct skills development for *maquila* industries. Stronger efforts should be made to develop skills that can be generalised throughout the labour market so that a worker can carry them from one plant to another or move up in the hierarchy of employment responsibility and compensation. Tertiary education institutions need to develop their capacity to provide lifelong learning opportunities, including "second chances" and reskilling and upskilling opportunities, such as executive education, directed at the technically-skilled workforce that is growing in Sonora. Given Sonora's need to build a knowledge economy and infrastructure serving its diverse industrial base, changes to the tax regimes governing the *maquila* industries should be considered in view of the need to invest in long-term economic development.

There is considerable diversity among tertiary education institutions in terms of their productivity and labour market relevance of education. Productivity, retention and completion are a problem in many institutions: dropout rates in Sonora's TEIs have remained consistently above the national average. For example, the 2010/2011 dropout rate in Sonora was 11.6%, compared with 8.2% nationally. Greater academic, financial and social support would allow first generation students to access tertiary education and complete their studies. Currently, the lack of data on students' academic progress has limited the possibility of estimating the need for academic and social support. In most cases, curricula remain focused on narrow skills or qualifications rather than wider skills and competencies that can be generalised across the labour market and enhance the ability for lifelong learning. Building on the existing examples at ITSON and UE (*Univerisdad Estatal de Sonora*, formerly CESUES), Sonora's TEIs could

develop a stronger approach to competence-based curricula. In addition to student internships, a range of measures would improve the labour market relevance of education. These include mobility schemes where employees act as instructors while tertiary education staff members temporarily work in industry. Inclusion of labour market representatives in the curriculum and course design, and the governance of tertiary education institutions could also improve the relevance of tertiary education and strengthen the skills and competencies of students.

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***Sonora's universities are facing a potential crisis of supply for university teaching and research capacity. It is unclear where the next generation faculty will come.***

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Sonora's tertiary education sector suffers from a lack of long-term planning for university teaching and research capacity. Short-term appointments predominate in the university faculty ranks. Universities do not have sufficient programmes to support basic research across a range of fields, which places them in danger of losing talented postgraduates to universities in other countries. Faculty to supervise Masters and PhD students is shrinking. There is no evidence of strategies to develop and retain research talent or plans to replace an ageing teaching faculty in universities.

An education quality crisis may develop in Sonora due to increasing demand for education at all levels. Most significant to this potential crisis is evidence that support for faculty researchers/mentors and basic research has diminished as a proportion of total tertiary education expenditure. In some cases, educational programmes are admitting more students in order to fund their faculty, with the result that they are unable to supervise the admitted students, resulting in declining programme quality.

While Sonora's universities need to improve the quality, equity and relevance of their undergraduate education, they also need to continue their efforts to develop and expand postgraduate education. In designing postgraduate programmes, Sonora's universities could consider introducing joint doctoral schools and "structured doctoral programmes" that provide a framework for timely completion over four years and a framework for interdisciplinary modules, transferable skills and industry collaboration as a means of enhancing research career development in academia and industry.

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***Sonora needs a state-wide mechanism to articulate a long-term vision and an integrated development strategy for all educational***

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*institutions. Strengthening evidence-based decision making is necessary.*

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If Sonora wants to move up in the global value chain, it needs a co-ordinated, long-term strategy and a systemic approach ranging from secondary education to tertiary education and lifelong learning in order to continue to improve overall education levels, develop a highly skilled workforce and an economy that can absorb this workforce. The current technical education programmes that respond to the demands of individual companies need to be developed and evaluated within a long-term strategic plan for tertiary education in the region. The state education authorities need to be more proactive in setting the tertiary education agenda rather than leaving it to economic development actors who may do an excellent job for particular enterprises, but lack the broader educational picture of Sonora. Building a stronger strategy for human capital and skills development in Sonora requires four key elements: first, robust data on the status of the region's human capital; second, a policy audit to identify barriers to meeting needs; third, state/federal policies to foster tertiary education institutions with multiple, complementary missions aligned with regional needs; and fourth, a revision of student selection, finance policy (institutional, state and federal per-student funding as well as student support) and governance/regulation.

Sonora's tertiary education system requires more robust performance measurement, data collection and benchmarking so that the government and institutions can track their progress. At the state level, information on access to education and on institutional performance is limited and lacking authoritative status. There is a need for a state-wide, demographically-informed, data-based information system, grounded in a limited number of ambitious and measurable goals, such as improving educational attainment level by raising secondary, upper secondary and tertiary education attainment levels and reducing dropouts throughout the education system in order to provide the basis for planning, resource allocation or performance evaluation. Robust data and diagnostic analysis are also necessary to plan for longer term educational objectives and to meet broad labour force needs, such as those emerging in human services and tourism. These needs can be met through public sector needs analysis based on demographic data, an examination of the capacity of public sector service providers and their plans for service provision and improvement, and proactive efforts to contact and assess needs in SMEs. Additionally, tertiary education institutions need the common fact base provided by benchmarks to serve as an external reference for their own performance. As part of the COVES (Sonora State Connection Council) agenda, the state of Sonora could agree with the tertiary education institutions on standard practices for recording



and measuring productivity and publishing tertiary education productivity data. Without comprehensive and accessible data, institutions cannot be held accountable for their progress.

**The following measures would promote human capital and skills development in Sonora:**

*Recommendations for the federal government*

- Re-evaluate the numerous special business tax regimes that subsidise foreign direct investment and review incentives with the long-term workforce and economic development needs in view.
- Review funding arrangements for tertiary education, taking into consideration and reducing the wide differences in funding per student across the sector and within subsystems to ensure the growing demand for tertiary education in Sonora is met with adequate funding for the maintenance of quality programmes. If programmes are self-funded based on the number of students admitted and insufficient faculty are available to instruct those students, educational performance will suffer.
- Review universities' funding model to develop a plan to renew faculty who can supervise postsecondary and postgraduate students. Take steps to retain and attract junior faculty who can build careers in universities, doing research and teaching the researchers and faculty of the future.
- Develop an initiative to focus on training low-skilled people to move from the informal to the formal sector of the economy. Facilitate the move from the informal to the formal sector, for example by helping micro-entrepreneurs with outreach and training to “scale-up” their micro-enterprises in sectors such as hospitality.

*Recommendations for the state government*

- In collaboration with tertiary education institutions, other educational institutions and key stakeholders in the economy and society, develop a co-ordinating structure (or build on existing structures such as COVES) and appropriate mechanisms to articulate a long-term vision and strategy for human capital and skills development that stretches from primary education to tertiary education and lifelong learning (including workforce development activities). Outline clear qualitative and quantitative goals, policies and priorities for human capital development from primary to tertiary education, and confirm the respective contribution of individual institutions (or types of institution). Build and co-ordinate relationships among the different components of the

education sector to address pathways between universities and technological institutes, and between different levels of education.

- Develop an authoritative, data-driven infrastructure to inform evidence-based decision making, goal setting and evaluation for the secondary and tertiary education sectors. Monitor the performance of tertiary education in the region and benchmark its progress with appropriate comparators in the country and with OECD countries. This requires: i) robust data on the status of the region's human capital, ii) a policy audit to identify barriers to meeting needs, iii) state/federal policy to foster tertiary education institutions with multiple, complementary missions aligned with regional needs, and iv) revision of student selection, finance policy (institutional, regional and national student support) and governance/regulation. Develop data and information on: i) educational attainment rates benchmarked to country-level achievement, the OECD average and the best-performing OECD countries, ii) migration by educational level and age, iii) regional tertiary education participation rates (age groups including youth, adults; socio-economic status), iv) robust information on which institutions serve the region's population, v) long-term labour market needs, vi) degrees awarded by regional tertiary education institutions, vii) student labour market outcomes and viii) functioning pathways between and among tertiary education institutions, as well as other levels of education. Publish the comprehensive labour market intelligence online in a single place to improve students' ability to make rational choices about their studies and to help graduates and employers come together and increase the graduate employment. Use this data to identify regional priorities and facilitate the access of TEIs to the data to help develop relevant education and skills.
- In collaboration with the tertiary education institutions, continue to expand efforts to increase the enrolment and success of students from low social and economic backgrounds. Facilitate the removal of the remaining geographical barriers to education with the help of ICT, academic, social and financial support services for students and collaboration and pathways between universities and technological institutes, as well as between tertiary education and the primary and secondary education institutions. Focus attention on teacher training colleges and how secondary school teachers are prepared. Experiment with approaches to increase the average years of school completed and to decrease desertion (drop-out) rates. These may include community development efforts that reach parents and opportunities to continue education while working.

- In collaboration with the tertiary education institutions, increase tertiary education opportunities for working age adults, ensuring that the workforce development for the maquila industries also provides general skills that enable mobility. Ensure that this training is available to workers outside the maquila industries as well. Lifelong learning measures should include transparent pathways to advanced education, the ability to attend multiple institutions, obtain short-term education and training that can later be applied to degrees, and re-skilling and up-skilling courses and programmes designed around the needs of working adults. For non-traditional learners who combine work and study and/or family obligations, develop flexible ways of education provision through work-based, e-learning and distance education and allow attendance on the basis of non-formal learning. This involves the development of a qualifications framework with strong credit recognition schemes, course and programme articulation agreements, clear and enforceable policies related to credit transfer and support for joint and collaborative programmes.
- Develop a long-term plan to meet broad labour force needs in the regional economy, based on a diagnostic analysis. Evaluate the technical education programmes that have been developed to meet the demands of individual companies. Develop these programmes within a long-term strategic plan for tertiary education in the region. Meeting the needs of the emerging sectors, such as human services and tourism, will require proactive efforts to contact and assess needs in small and medium-sized enterprises (SMEs) not represented by trade associations or economic development agencies or organisations. Public sector needs analysis should draw on demographic data as well as an examination of the capacity of public sector service providers and their plans for service provision and improvement.
- Provide micro-enterprise business training to move people from the informal to the formal sector. Expand programmes to train micro-enterprise entrepreneurs building businesses in industries such as tourism and waste management.
- Develop strategies to increase the supply of knowledge-intensive workers and to integrate them in the sectors in which the region has comparative advantages. This is beginning in the tourism sector (which engages historians and anthropologists in cultural heritage programmes, as well as performing and visual artists), but connections could be strengthened.

***Recommendations for tertiary education institutions***

- Increase the proportion of longer-term appointments in the faculty in order to foster faculty research, improve quality of teaching and enhance contributions to university governance. In order to improve the quality of all tertiary education programmes, gradually reserve academic positions only for candidates with a Masters degree or higher and fix a period for those who wish to follow an academic career to complete their doctoral studies. Provide comprehensive professional development programmes for university teachers. Provide regular short courses to improve teaching skills, encourage assessment and feedback from students, and support and reward excellence in teaching.
- Develop policies, programmes and measures to improve, on a continuous basis, the quality and relevance of study programmes. First, review the curriculum content and pedagogical methods of study programmes to align them with the needs of the labour market and the local and regional economies. The opinion of employers and graduates should play an important role in the systematic and continuous revision of the education programmes of tertiary education institutions. Evaluate academic programmes and curricula that create bridges between skill levels, for example, from technician skills to post-graduate engineering programmes. Make it clear how students could move up the skills ladder, assessing, for example, opportunities to combine work and education and mentoring programmes. Second, evaluate generic skills such as critical thinking, problem solving, written output and interpersonal understanding in curriculum design, and the development of teaching and learning. Third, create robust methods to monitor student progress and achievement, labour market outcomes and mobility, as well as graduate destinations (out-migration). Monitor studies that analyse the entry of graduates into the labour market. Systematically monitor student progress, achievement and labour market outcomes. Use the data strategically to improve academic, financial and social support for students, course provision and the supply of skills.
- Construct flexible learning paths and institutional bridges that include tertiary-type B post-secondary education. Put in place measures to accommodate and encourage mobility within and between institutions by formal agreements to help students move from one institution to another.
- Address the need for lifelong learning and more flexible modes of delivery for those who combine work and study. Develop executive and lifelong education directed at the technically-skilled workforce, which

will increase in the future thanks to the growing pool of technically-skilled workers in Sonora.

- Collaborate more actively with industry to ensure greater relevance of the educational provision and to build graduates' entrepreneurial skills. Engage employers in curriculum development, invite professors from industry to deliver courses, and develop experiential, problem-based, interdisciplinary and work-based learning methods to develop employability, entrepreneurial and transferable skills, management capacity and English language acquisition. Embed transferable skills in degree programmes across the academic and technical disciplines to boost the productivity base in Sonora and enhance its internationalisation efforts. Develop a stronger student-centred approach in teaching and learning, building on international best practice and the existing models in Sonora. Develop more interactive forms of education tailored to students' individual needs and capacities.
- In collaboration with other TEIs, develop a joint doctoral school and “structured doctoral programmes” that provide a framework for timely completion and a framework for industry collaboration. To enhance research training and research career development within academia and industry, incorporate in the doctoral training discipline/interdisciplinary courses, transferable skills and mobility, such as through internships in the public, private and the non-profit sector.

## Research, development and innovation

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*Among Mexican states, Sonora ranks among the highest for its participation in the knowledge economy. In order to fully exploit its advantages, Sonora needs to strengthen its research trajectory and foster its contribution to Mexico's technological output. While universities and high-level technological institutes are numerous in the state, they are not yet actively engaged in technology transfer.*

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Sonora exhibits medium to high performance for regional competitiveness compared to the rest of Mexico. It comes in at 10th place in the ranking of the Mexican Institute for Competitiveness (IMCO) and performs well for its share in the knowledge economy (4th place). At the same time, R&D spending is more modest (Sonora ranks in the middle of the list for state expenditure of national STI programmes) and patenting is marginal (18th place).

Research in Sonora's tertiary education sector is highly concentrated: four institutions – UNISON, CIAD, COLSON (Colegio de Sonora) and ITSON – account for 99% of Sonora's researchers in the National System of Researchers (SNI) and 83% of all public researchers. At the same time, Sonora's SNI researchers represent only 2.27% of the national total, and two-thirds of them are at UNISON. Universities' R&D spending remains fragmented and limited in volume for most research domains. R&D is mainly undertaken in the sectors of engineering, natural resources, basic sciences, agrofood and life sciences. Data from the National Council of Science and Technology (*Consejo Nacional de Ciencia y Tecnología*, CONACYT) demonstrates that Sonora has moved away from supporting basic research and the institutional programmes that support the development of young scholars. There is poor support for basic research outside of the fields of mineralogy and biotech, which are related to Sonora's key industries, mining and agriculture. This means that while existing industry needs continue to be served, basic research in other areas critical to the state's economy, including renewable energy or regional science and logistics, is not currently on the agenda.

Despite Sonora's relatively modest R&D performance, efforts have been made to transform universities' research results into innovation. Several tertiary education institutions are running incubators. About 22 incubators are in operation in Sonora, but only one can be classified as high-tech. Furthermore, Sonora's universities and other tertiary education institutions do not have specific mechanisms or tools to transfer technologies, only "connection offices" that have recently started to co-operate with other institutions in Mexico. UNISON's technology transfer office has not yet achieved the creation of a new business via technology transfer. Similarly, technology transfer units in the technological institutes are insufficiently professionalised. Most of the new strategic initiatives come from ITSON, which is running a software factory (NOVUTEK), an agribusiness park (DIAPyME), a technological centre for small business (CETIDE) and a range of social programmes such as CUDDEC. At the same time, ITSON faces difficulties generating sufficient R&D and reaching critical mass for its activities.

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*There is room for improvement in university-industry relations and making Sonora's Regional Innovation System stronger and more consistent.*

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Higher Education R&D (HERD) in Mexico remains very low, amounting to less than 0.04% of the national GDP. The share of HERD financed by the business sector is negligible (0.1 %) and limited progress

has been made in university-industry interactions. Dialogue with business is often conducted through forums, which seem to be organised discretely and not as a continuous effort to create a link with small firms. Collaboration between firms and TEIs in Mexico only accounted for 0.5% of the products and 2.4% of the innovative processes involved in developing innovation projects in 2001. According to OECD Review of Innovation Policy: Mexico (2009) these figures increased slightly in 2006, reaching 1.8% and 2.8% respectively. No robust data for Sonora was available for these indicators, but there is no reason to believe that the situation would be much different. The lack of university-industry connections is manifest in the limited extent of applied research activity in Sonora and its TEIs. Programmes such as “Entrepreneurs and Enterprise Incubators” have been established at some TEIs, but faculty are rarely recognised for participating in these applied efforts so their participation has been limited. One exception is *Centro de Asistencia Metrológica* (CAM) at UNISON, which has worked consistently with Ford Motor Company and its suppliers in Sonora.

Because of the lack of policy efforts to link SMEs and TEIs, there are limited incentives for TEIs to build stronger relations with SMEs or help them connect with the multinational companies. CONACYT’s programme for technological development and innovation addressed to companies emphasises linkages with the academic sector, but the scale of the programme remains modest; in 2010, EUR 8 million for 28 projects in Sonora. Stronger efforts backed up by funding mechanisms are needed to develop a “demand pull” for innovation in SMEs. Innovation voucher systems in many European countries and initiatives developed in other Mexican states, such as the Club of Innovators and the innovation networks promoted by Guanajuato Council for Science and Technology (CONCYTEG) could serve as a source of inspiration for Sonora.

The deficiencies in the business-science interface in Sonora constitute a major gap that state innovation policy needs to address. Other challenges include the weak absorption capacities of small firms and, consequently, the low share of business investment in process technological R&D (only 6%, below even the low 9% national average). Another issue is related to the relatively low participation of large international firms in Sonora’s regional innovation system. In Mexico, less than 2% of BERD (Business Expenditure on R&D) comes from abroad and Sonora is no exception. Large firms in the *maquila* industries tend to import technology and do not take part in local innovative networks. Moreover, the Mexican public sector provides only limited support. Public R&D spending is low according to international standards. Though Sonora received a relatively large amount of money from the federal funding scheme *Fondos Mixtos* compared to the average across Mexico, its total R&D assistance does not exceed EUR 15 million, whether

from the state or from the federal government. This is insufficient to strengthen the clusterisation process and to consolidate the loose links between firms, public research organisations, TEIs and multinational companies in Sonora. The final problem is the weakness or inexistence of intermediate organisations or venture development organisations.

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*State policy should make stronger efforts to target Sonora's two key advantages: the broad spectrum of industrial activities and the region's location close to south-western states of the US. There is a need to develop a plan and policy initiatives to develop management and entrepreneurial capacity for indigenous business creation and to link Sonora's TEIs with US businesses and TEIs.*

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Sonora's economy has made strong progress, enjoying 7% growth in 2011, above the performance of most Mexican states. While its industrial structure remains balanced, Sonora seems to be moving up the technological ladder. In Sonora, the manufacturing gross value added is realised for 43.4% (percentage of manufacturing industries) in the low-tech segment, 23.5% in mid-low-tech, 18% in mid-high-tech and 15% in high-tech. The state has increased its degree of specialisation in clothing, plastics and automobiles, but has witnessed decreasing specialisation in ICT and pharma during 1980-2003. In the last part of the 2000s, however, Sonora has made great strides in several sectors, improving its competitiveness in a number of high-tech niches. For example, activity in the aerospace industry in Guaymas has increased, with the cluster employing 7 000 persons in the region. In addition to aerospace, other sectors have shown steady growth in the past year, including agriculture, automobile, mining and fisheries. The *maquiladoras* have regained their competitive edge in recent years because of the rising price of products coming from emerging countries and increasing transportation costs. This development has been supported by large, often multinational firms, but the spill-over to the small business sector has been limited. Given the large number of SMEs in Sonora, many state programmes, including seven specific funds, target SME activities. These funds nonetheless give insufficient attention to small firms' innovation standing and none of them link SMEs to TEIs.

While Sonora has made significant progress in providing technical expertise to attract companies requiring higher value added skills, links to university research expertise and infrastructure that can enable entrepreneurs to develop new, domestically-based companies producing high value added products are less developed. Sonora's TEIs can contribute to the educational



opportunities that will develop entrepreneurial and management capacity. This type of education is provided by ITSON in the tourism and agricultural sectors, which may offer more opportunities for business creation for locally-based companies. TEIs could be a source of more market-oriented R&D by providing firms with innovation inputs through consulting contracts, joint projects and the development of innovative SMEs. R&D by technological institutes could complement the more academically-oriented R&D.

Sonora could also develop stronger synergies with the neighbouring US state of Arizona by encouraging TEIs' RDI collaboration. Sonora's economic development is closely linked with Arizona. Knowledge spill-overs could be fostered by encouraging co-patenting and other forms of co-operation in R&D. Exchanges between Arizona and Mexico mainly take place at the two main ports of entry in Sonora: Nogales and Douglas/Aqua Prieta. As much as USD 16 billion worth of goods passes through Nogales each year and USD 1.1 billion passes through Douglas. A total of 235 000 jobs in Arizona rely on trade with Mexico and 25.8 million northbound visitors cross the US-Mexico border annually at the state level. To build a dynamic, bi-national regional economy, closer co-operation could be developed in a number of fields including tourism, water, renewable energy, copper mining and waste management. The leading TEIs in Hermosillo and elsewhere in Sonora have not yet played a major role in the Arizona-Sonora co-operation. This is reflected in the low number of joint research projects conducted with South Arizona TEIs and firms. A new breadth needs to be instilled in the Arizona-Sonora collaboration in order to unleash the full potential of tertiary education for cross-border development.

**The following measures would promote regional innovation in Sonora:*****Recommendations for the federal and state governments***

- Articulate a state-level innovation plan and technological vision, and focus on implementation. Sonora's economic strategy has traditionally stressed the development of maquilas, recruitment policies and infrastructure building, rather than R&D and new product and process innovations. The state would nonetheless benefit from a clearer focus on technological perspectives. Drafting an innovation plan would help policy makers to develop a vision for Sonora's future and make clear technological choices. This requires the mapping of linkages between the state clusters and should lead to an assessment of the consequences of different technological assumptions and priorities. A state-level innovation plan would help policy makers focus on the merits of endogenous R&D policy for certain niche sectors (aerospace, alternative energy, desalinisation plant, logistics and measurement instruments) and to depart from the "technology-follower" model that has been prevalent in Sonora for the past decades. This framework will provide TEIs with a roadmap for the future and make their R&D programme more coherent and easier to evaluate. The process of designing the plan would be facilitated by referring to ITSON's Strategic Development Plan for Southern Sonora, which was developed at the end of the 2000s in collaboration with state and sub-state authorities. Given that Sonora underperforms in obtaining federal research funding compared to other states like Nuevo Leon and Baja California, an innovation plan would significantly help the state obtain more funding for innovation and R&D development from the federal ministries and CONACYT.
- Improve the alignment of universities' and technological institutes' education and research policies with the state's comparative advantages, bearing in mind the dominant role that low technologies continue to play in Sonora. The availability of skilled and semi-skilled personnel is a key factor in the choice of location for multinational companies. At the same time, MNCs target areas of strength within the state in order to foster their competitive edge. Even if the search for low-cost labour is playing an important role in FDI strategies, investors also look for skills. Sonora and Mexico are in competition with many other emerging countries trying to attract companies and talents. The higher education sector therefore needs to engage in regional development through a stronger focus on training in skills and technologies in Sonora's areas of comparative advantage. If TEIs want to become engines of economic growth in Sonora, they must align their teaching and education policies with the appropriate segments of the market. HE research policies

should also echo these concerns. Thus far, the distribution of nationally certified SNI researchers does not favour industrial research topics (only 11% of SNI researchers work in engineering and only 10% work in chemistry and biology). The technological institutes are also very weak in engineering R&D. A better balance of research that is more closely aligned to Sonora's specialisation assets must be achieved.

- Continue to build on good practices in technology transfer, such as focused parks like SonoraSoft Technology Park, and impose a rigorous cost-benefit and environmental analysis of large-scale programmes such as Knowledge City in Hermosillo. Thus far, Sonora has made moderate use of technology transfer instruments such as parks and incubators, but there are now ambitious plans to transform Hermosillo into a knowledge city. Many studies have shown that while university-based science parks perform better than non-university-based parks, they are not a panacea. There is limited evidence that networking with science parks has positive effects for SMEs. Various studies that compare firms located on and off science parks have shown limited evidence of significantly enhanced performance by the science park enterprises. Incubators, often located in science parks, are another mechanism for transferring academic research to start-up firms. The increasing development of incubators in Sonora is a welcome trend. There is, however, a risk of fragmentation, particularly for incubators linked with the new technological institutes. Focusing on the formation of sector-specific incubators, e.g. in the biotechnology or engineering sector, and state-wide networks may increase the chances of achieving the necessary critical mass to ensure the sustainability of these activities.
- Define frameworks and increase incentives for inter-university co-operation and joint programmes between higher technological institutes and universities. This process should involve the federal government (SEP, SES, and CONACYT) working together with the state authorities (State Secretary for Education and Culture). Many research and innovation opportunities are lost due to insufficient collaboration between different higher education institutions. Research in engineering (UNISON, ITESM-Monterrey Tech, ITSON, ITH, ITN, ITESCA, ITSC, ITSP) and in agribusiness and fisheries (UNISON, ITSON, Instituto Tecnológico del Mar, CIAD, Centro de Estudio Superiore del Estado de Sonora) is particularly fragmented. The technological institutes have often forged relationships with SMEs, providing them with technical assistance and co-operation in incremental innovation. They have also embarked on the process of building a common space (Espacio comun). This space needs to prioritise academic collaboration and the implementation of joint R&D

and innovation projects. Collaboration between universities and technological institutes should receive special attention, as it could help large institutions such as UNISON to improve their interaction with SMEs. This could be further reinforced by the creation of joint one-stop-shops that offer an integrated range of supply services to firms, emphasising the relationship between market-based and less-applied research. Mapping out the strengths and knowledge fields of different TEIs would be useful. Synergies could be developed through common projects and graduate theses.

- Promote an evaluation culture based on robust data at an institutional level. A more efficient tertiary education sector can act as a springboard for achieving a more innovative and robust Sonoran economy. Monitoring the outcomes and assessing the impact of engagement policies would help secure a greater innovation-based trajectory for Sonora's economy. State authorities should embark on a comprehensive evaluation programme of their tertiary education policy and its outcomes. This would imply regular strategic meetings between agency directors and university rectors with the goal of regularly assessing progress. This would require the establishment of a data collection methodology, the use of indicators and the definition of the assessment's objective. With regard to policy support for technology transfer or network creation, Sonora's authorities should build an evaluation platform that uses indicators such as the number of business ideas screened and the number of development products generated. In the case of university start-ups, incubators and science parks, indicators should include the capacity of these organisations to establish large scale partnerships and to obtain private funds. The number of universities involved and the number of firms and jobs created are often quoted as indicators of success. More sophisticated analysis, such as using questionnaires addressed to customers or cost benefit analysis of programmes, would be welcome.

### *Recommendations tertiary education institutions*

- Forge stronger links with the SME sector and relevant industry clusters (this is especially important for UNISON). Align institutional education policies and research programmes with the demands of the state economy. Give more attention to internship policies and long-term collaboration with the private sector.
- Streamline institutional internationalisation policies and diversify areas of research collaboration. Some TEIs have signed a great number of agreements that often remain umbrella frameworks that do not lead to concrete projects. While EU co-operation is excessively focused on the

agribusiness sector, there is strong potential for collaboration in Sonora's other areas of strength such as engineering, solar energy and water technologies.

- Clearly articulate institutional technology transfer policies and increase networking with other institutions. Focus on specialising the incubators and increasing the professionalization of technology transfer offices in areas where a sufficient critical mass of researchers can be achieved.
- Make efforts to ensure a broad diffusion of entrepreneurship programmes in education institutions, notably technological institutes. Give these programmes an important role in the education strategy of the institutions.
- Despite the recent increase in the number of entrepreneurship support programmes at the federal level, e.g. within the framework of PeCiTi (a federal programme for STI) and national efforts to diffuse a culture of entrepreneurship among researchers (Programme Mexico Emprende), Sonora's universities and technological institutes are not fully mobilised to develop a comprehensive approach to entrepreneurship teaching. While UNISON has implemented a programme to diffuse enterprise culture (Programma institucional de Fomento a la Cultura Emprendedora) that is based on lectures, focus groups and product displays and ITSON has hosted a 2012 event called Caravan of the Entrepreneur, which aims to raise awareness and drive society towards more entrepreneurial and innovation-oriented attitudes, entrepreneurship is in most cases not part of the core curricula. Scaling up the effort made by ITSON, steps need to be taken to create comprehensive entrepreneurship modules and to integrate them into the curricula.

### **Contribution to social, cultural and environmental development**

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*Sonora is one of the wealthiest states in Mexico, but faces many challenges. These challenges can provide an opportunity to develop a more resilient and sustainable economy by up-scaling TEIs' RDI effort, learning programmes and community outreach, and seeking complementarities of social and economic goals.*

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Sonora is one of Mexico's wealthier states, but it continues to face many challenges such as poverty and large income inequalities, intra-regional disparities, inter-ethnic and gender inequality, and environmental challenges. The geographic distribution of the population across the state

results in unequal access to services, such as tertiary education, which particularly affects people in rural areas. The rural population in Sonora is poorer than the urban population, and includes a higher proportion of the indigenous population, among which the poverty rate is higher. Environmental challenges include the severe drought that Sonora has experienced since the mid-1990s. The demand for water in the urbanising northern portion of the state and the continued demand for water by agricultural water users in the southern part have produced water disputes, but no long-term solutions to the water shortage. Sonora's water situation is likely to deteriorate due to in-migration, land and real estate development, and inefficient use of water resources. All of these challenges provide an opportunity to develop a more resilient and sustainable economy through up-scaling TEIs' research, development and innovation efforts, learning programmes and community outreach, and by seeking complementarities between social and economic goals. For example, focusing efforts on environmental sustainability could bring improvements to the quality of life in low-income neighbourhoods, but also help develop endogenous business development in Sonora, as many examples of frugal innovations in India show.

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*The ongoing growth-enhancing and equity-seeking initiatives should be better co-ordinated, institutionalised, rewarded and profiled within institutions, local and regional communities, and state and federal governments.*

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The various efforts by Sonora's TEIs indicate recognition of the key challenges in Sonora, but due to the lack of a long-term vision and strategy, co-ordination, investment and technical challenges remain to be addressed. Despite significant efforts, resources are often spread thinly, and the scope and impact of the activities remain limited. There are many fragmented, sector-specific, uncoordinated initiatives, none of which have the critical mass to generate projects that could have a significant impact at the local and regional level and generate multiplier effects. There is limited evidence of collaboration across the tertiary education sector, and in most cases (although not all), a lack of focus on the implementation and monitoring of results, which could help evaluate the outcomes of the outreach activities and scale up good practice examples into a system. There is also a lack of co-ordination among activities, programmes and plans between the state government, municipalities and TEIs.

The opportunities for sustainable and extended third mission activities in Sonora's tertiary education institutions lie in building on and scaling up

current good practice models that take an integrated, demand-led approach to local economic and social development. Examples include ITSON's community development centre CUDDEC, tourism trails and other initiatives that help widen access to education and address critical environmental challenges. These growth-enhancing and equity-seeking policies and practices should be recognised by the public and private stakeholders as important to Sonora's future. Without public acknowledgement and funding, university-led community programmes are vulnerable to cuts and downsizing when governments and institutional leadership change. Sustainable engagement in these areas will require prioritisation and building critical mass. It will also require closer collaboration and co-ordination, mobilising both private and public sources, and aligning the projects more closely with the federal and state initiatives.

**The following measures would promote social, cultural and environmental development in Sonora:**

*Recommendations for the state and local authorities*

- Create a forum for the systematic exchange of information and experience among tertiary education institutions with regard to social, cultural and environmental matters. This forum could organise thematic events with regular information retrieval and exchange facilitated by a dedicated website. The forum would permit the tracking and monitoring of different initiatives and their outcomes, along with the identification of best practices for publication and policy fine-tuning. As a first step, all the social initiatives and projects of tertiary education institutions should be mapped and published in a shared platform. Build on existing examples of good collaboration between universities and local government, most notably ITSON's work in southern Sonora, which could be used as a model for collaborative and joint intervention in other areas.
- Provide incentives in the form of competitive funds (with public and private support) dedicated to supporting “challenge-driven” research to connect university research to community development. Incentivise “translational research” and frugal innovation to address the critical issues in Sonora.
- Collaborate with the public and private sector to support sustainable environmental and economic development through a comprehensive regional approach, where tertiary education institutions can contribute to the diagnosis of regional environmental conditions and sustainability,

the ecological education for the community at large and research solutions to existing environmental problems.

- Mobilise TEIs to contribute to environmental sustainability by encouraging the Commission of Ecology and Sustainable Development of the State of Sonora (Comision de Ecologia y Desarrollo Sustentable del Estado de Sonora, CEDES) to identify and directly engage with TEI researchers with the capacity to contribute to approaches to environmental issues in a multi-disciplinary framework.

### ***Recommendations and other tertiary education institutions***

- Improve the monitoring and follow-up of the success and results of the community engagement initiatives, projects and programmes to provide evidence of their impact and to show the return on public investment, building on the example of CUDDEC. The lack of robust and comparable data constrains the visibility and impact of universities' activities. It also makes it difficult to measure the real success or failure of programmes.
- Align initiatives for social, cultural and environmental development with the plans designed by the federal and state authorities in order to have a stronger impact at the local and community level. Collaborate with other tertiary education institutions in the design and implementation of extension activities.
- Engage in long-term community development through collaborative projects between the community and TEIs for developing research and innovation, as well as involving students in community service and experiential learning. These partnerships should empower communities to find their own solutions to the economic, social, cultural and environmental challenges they face, which are local, national and global in nature. Learn from and scale up successful models such as the CUDDEC facility and programmes to enhance TEIs' impact on economic and educational opportunities in low-income communities.
- Mobilise networks for international co-operation on issues related to the social, cultural and environmental development of the region. Engage in projects with other regions in the world that are experiencing similar problems, for example between Mexico, Malaysia, Chile and the US, with an emphasis on South-South collaboration.
- Contribute to the development of the local/regional tourism economy by developing and expanding programmes in entrepreneurship and non-profit management, both in formal degree programmes and through outreach efforts.



- Mobilise and build on existing cross-border collaborations between US universities and colleges and Sonora’s TE campuses across the border for urban, energy and environmental planning. For example, develop Geographic Information Systems collaboration focused on environmental/hydrologic conditions in Sonora through bi-national research programmes.
- Develop a co-ordinated, multidisciplinary, cross-institutional research effort to address water access and water quality in the state.
- Develop a process for evaluating the environmental footprint of TEIs’ expansion in the state of Sonora. Support both individual and collaborative initiatives to foster university demonstrations of green building practices, including retrofitting old buildings.

### Globalisation and internationalisation

*To maximise its opportunities in the global economy and to shift towards more inclusive development, Mexico needs to move up the value chain by continuing the process of structural reforms and improving the quality of its education. Sonora, like other Mexican states bordering the United States, is part of the global value chain, but now needs to mobilise its tertiary education to move up the ladder.*

In the past few years, Sonora’s tertiary education system has made considerable progress in advancing the internationalisation process. Its results and impacts remain modest, however, considering the size of the tertiary education system, Sonora’s economic strengths, its proximity to the US and the overall needs of the region. While the internationalisation of tertiary education institutions embraces student mobility, faculty mobility and curricular development, the only existing mechanism of internationalisation in Sonora’s universities and tertiary education institutions is traditional student mobility, which remains limited in number and scope: on average less than 0.1% of the total enrolment. International activities stem from individual initiatives and students’ and scholars’ interests. This piecemeal strategy is not enough to transform the tertiary education system into an internationally competitive system. In the absence of adequate strategies, Sonora’s TEIs are developing international activities that remain marginal to institutional policies and disconnected from institutional plans and priorities. The main challenge is the *ad hoc* nature of institutional policies, which limit the scope of present activities and their

synergy within the community, and prevent TEIs from reaping the benefits from globalisation, international co-operation and mobility flows.

Internationalisation strategies and activities can support the transformation of Sonora's tertiary education system only if a systematic approach to the process is implemented by the institutions. For this to happen, TEIs need to develop a comprehensive internationalisation strategy at the institutional level, embracing all the sectors and functions of the university. To overcome the fragmentation, they will need to update their organisational structures, equipping their international relations offices with responsibilities in the overall institutional strategy. In addition to South-North co-operation, Sonora's TEIs should focus on South-South co-operation.

**The following measures would help widen and deepen the internationalisation process of Sonora's tertiary education system:**

*Recommendations for the state government*

- In collaboration with the TEIs, design and implement a strategy to promote the state tertiary education system as an international destination for students and actively participate towards this end in different TE international events (see Box 5.4). Take full advantage of the opportunities provided by the Sonora-Arizona and Sonora-New Mexico Commissions to support this goal by developing adequate mechanisms and structures that will foster student and faculty mobility, innovative joint-degree programmes and RDI collaboration.

*Recommendations other tertiary education institutions*

Restructure organisational strategies for the further advancement and viability of the institutional internationalisation process. To do so, the following steps are recommended:

- Restructure and update procedures in respect to planning, management, budgeting and assessment.
- Develop a comprehensive institutional plan for internationalisation based on the prior assessment of institutional strengths and areas for improvement, and establish institutional priorities for internationalisation activities.
- Create wider awareness within the TE and wider community on the importance and benefits of internationalisation for students, faculty and staff.

- Link internationalisation strategies to policies for innovation, quality improvement and staff development.
  - Create the necessary budget conditions for the implementation of the internationalisation programmes.
  - Create a supportive academic and administrative culture through the establishment of institutional policies with respect to human resources, legal regulations and management structures.
  - Enlarge the functions of the international office in order to co-ordinate the overall institutional strategy under the direction of an internationalisation committee. The office functions should include: the co-ordination of all international activities and programmes including student, faculty and researcher mobility; the internationalisation of the curriculum and research; the recruitment of international students and their interaction with local students and the community; institutional participation in international networks and associations for TE collaboration; the promotion and communication of internationalisation process strategies; the establishment of an institutional database on internationalisation and internationally-experienced faculty; the co-ordination of special programmes of international demand, such as Spanish language programmes.
  - Assess and continually enhance the quality and impact of the different aspects of the internationalisation process.
  - Encourage staff and faculty internationalisation through the establishment of a reward and recognition scheme for their involvement in international projects.
  - Link government policy and institutional initiatives for internationalisation.
  - Take advantage of support structures for internationalisation at national, regional and supranational levels such as databases, exchange of experiences and information.
- Develop comprehensive programmatic strategies:
- Link internationalisation strategies to innovation, teaching, research and curriculum policies.
  - Design and implement the different programmes related to the comprehensive internationalisation strategy that is linked to institutional priorities.

- Integrate an internationalised curriculum into the general curriculum and academic offering, linking this process to the quality assurance system.
- Promote the establishment of international joint-degree programmes as a means of internationalisation of the curriculum, academic model and offering; use international academic models like Tuning to aid curricular design; set up academic offerings in area studies or internationalised general education courses available for all academic programmes in order to develop students' global awareness, or establish a common curriculum cutting across all programmes including international general education; establish research centres or programmes on different regional world areas (North American, Asian and European studies).
- Design strategies to integrate foreign and domestic students in the classroom and in extracurricular activities.
- Promote the use of ICTs for virtual international student mobility.
- Broaden the offering of Spanish courses or special courses for international students; establish a unit in charge of designing, co-ordinating and monitoring the institutional strategy for the teaching of foreign languages across the curriculum to implement a unified teaching methodology, course contents, standardised exams and recruitment of faculty specialised in the teaching of foreign languages.
- Promote internationalisation of research through a better organisational strategy and enhanced availability of financial resources.
- Design a dedicated strategy for international accreditation of programmes.

### **Capacity building for regional development**

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*Federal and state policies encourage government-university-industry collaboration. Sonora has established “connection councils” at the state, regional and institutional levels. While the machinery is in place, there is now a need to identify regional needs and development trajectories, and establish adequate incentives and monitoring systems.*

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The Federal Government and the state government of Sonora have both acknowledged the key role that the tertiary education institutions can play in economic and social development. Federal and state policies such as the National Development Plan 2007-2012 (PND), the Sectoral Plan for

Education (PRONAE) and Sonora’s State Education Programme 2010-2015 (PEE) have emphasised the importance of TEIs’ third mission and have encouraged the formation of “connection councils” as a mechanism to build capacity for TEIs’ engagement activities. In Sonora, connection councils have been established at the state, regional and institutional levels to promote education-government-business links. Sonora was one of the first states in Mexico to establish a state-level connection council, COVES (*Consejo de Vinculación del Estado de Sonora*), in 2011. Connection councils have been replicated in eight regions and most of Sonora’s TEIs.

While machinery is now in place for long-term collaboration, it remains necessary to develop detailed knowledge of the needs and opportunities of Sonora and the TEIs’ research and education portfolio so that when opportunities arise, the development agencies can identify the appropriate institution or part of an institution to be engaged in the negotiation process. Building on the existing expertise, such as ITSON’s Strategic Plan for Regional Development in Southern Sonora based on Innovative Ecosystems (*Plan estratégico para el Desarrollo regional basado en ecosistemas de innovación*), could facilitate assessing regional needs and development trajectories.

Federal government and state government could also consider introducing a funding and monitoring mechanism to support university/TEI business and community engagement. Internationally, such mechanisms include the Higher Education and Innovation Fund for England (HEIF) and the associated monitoring system the Higher Education and Business and the Community Interaction Survey (HEBCIS). In the US, the Kentucky Regional Stewardship Program provides an example of a programme promoting regional or state-wide economic and social development through university engagement. This programme offers infrastructure funds to support the development and maintenance of engagement, regional grant funds for comprehensive university efforts to build intellectual capacity in priority areas and the stewardship initiatives pool for strategic initiatives.

The issue of incentives is also important at the individual level. Currently, the criteria for staff recruitment and promotion in Sonora’s TEIs do not sufficiently encourage activities related to local engagement and few incentives exist to encourage regional engagement of tertiary education staff. TEIs in Sonora could find inspiration from the University Rovira i Virgili in Spain and the Universiti Sains Malaysia that have introduced a “Research and Academic Staff Agreement” and a “3-track promotion exercise” respectively to acknowledge research, teaching, and community engagement or industry collaboration to reward and incentivise staff.

**The following measures would enhance capacity building for regional development:**

***Recommendations for the federal government***

- Strengthen institutional capacity of TEIs to ensure relevance of education and application of knowledge to economic and social needs.
- Allocate a special budget of the federal government to promote specific linkages in addition to existing initiatives. The UK HEIF funding could provide inspiration.
- Promote a model of facilitators or managers and other personnel of connection councils and units responsible for translating business issues to the academic agenda and generating specific collaboration projects.
- Analyse existing regulations and propose improvements in legal and institutional framework that facilitate connection between academia and industry.
- Evaluate the National System of Connection continuously; establish indicators to measure performance and impact to ensure that the system functions properly.
- Establish and promote incentive schemes that give priority to research that serves the needs of the regional/local domestic industry.

***Recommendations for the state government***

- Strengthen the co-ordination function of the state-wide COVES in order to better identify regional priorities and more efficiently apply the resources and expertise of regional connection councils.
- Develop incentives for TEIs to engage in regional development via regional connection councils. The Kentucky Stewardship Program could provide an inspiration.
- Conduct surveys of TEIs to assess their experiences and challenges participating in regional councils in order to improve collaboration and co-ordination with the productive, service and social sectors.
- Incentivise TEIs to develop a common set of measures to assess outputs and outcomes of their regional engagement.
- Provide incentives to TEIs to improve the connection council's professional capacity for regional engagement.

- Strengthen the engagement of TEIs as institutional partners in developing and implementing state plans and strategies.
- Encourage companies to work collaboratively with TEIs in areas of mid- and long-term labour needs planning, technology development and application.
- Building on the existing successful models, develop capacity in regional data gathering and sharing regional data repositories as a basis for identifying regional priorities.

### ***Recommendations tertiary education institutions***

- Develop internal incentives for faculty/researchers to engage in specific committees established under connection councils.
- Document the present linkages and publicise them within the region and within the institutions to raise the profile of tertiary education as a region builder.
- Assess needs for professional capacity building within the connection council and invest in strengthening its professional capacity building.
- Use regional connection councils as a platform to strengthen co-ordination among local and regional TEIs and to promote a “common tertiary education vision” to policy makers.
- Utilise the experience of individuals and groups within TEIs who are actively involved in providing advice to regional agencies to assist the academic leadership in guiding the institution’s policy and practice as it pertains to regional engagement.
- Review existing efforts in developing methodology for evaluation of the TEIs-industry sector linkage, modify and adopt common measures.
- Design and implement tangible rewards and incentives, including new employment and human resources management practices, in support of individual and institutional regional engagement. Review staff recruitment, hiring and reward systems so as to include the regional development agenda. Create mechanisms to systematically monitor and evaluate the activities in this area, to share good practice within their institution and benchmark this experience with other organisations and localities.
- Through feedback to COVES and regional councils, contribute to the improvement of co-ordination and management of regional links.

- Educate faculty/staff about the benefits of regional engagement, and maintain pressure for mainstreaming of regional engagement into research, teaching and service functions
- Utilise existing expertise in regional economic analysis and modelling (e.g. ITSON's Strategic Plan for Regional Development in Southern Sonora based on Innovative Ecosystems (Plan estratégico para el Desarrollo regional basado en ecosistemas de innovación)) as a basis for collaboration with government, productive and social sectors in assessing regional needs and development trajectories.