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# Opportunities for National Life Cycle Network Creation and Expansion Around the World

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# Opportunities for National Life Cycle Network Creation and Expansion Around the World

***With a special focus on mainstreaming and LCA database development in emerging economies, based on a global survey***

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# Executive Summary

Over the past two decades, life cycle approaches and tools (see definitions in 1.2 'Life Cycle Approaches and Concepts') have been developed and refined and have become more commonplace in the private and public sector. While mainstreaming life cycle thinking remains an ongoing effort, life cycle approaches are already stimulating and supporting the transition to a green economy.

Among other actors, the UNEP/SETAC Life Cycle Initiative has been a key driver to foster the development of life cycle approaches and promote their application globally. As part of their flagship project 2a on 'Data and database management', a global survey was carried out in 2014 to assess the status of life cycle networks and life cycle assessment (LCA) database development around the world. This report provides an overview of the survey results, which have been augmented through consultations with experts on different regional aspects.

The survey was mainly distributed via the UNEP/SETAC Life Cycle Initiative's global mailing list, which has more than 2500 subscribers, of which more than 10% participated in the survey. Due to their economic and political relevance, the report focuses especially on G20 countries plus Switzerland as well as on the European Union's target countries which are not included in the G20 group where a momentum for promoting life cycle approaches has been identified (e.g. Thailand).

## Life Cycle Networks

The survey used the definition by Bjørn et al (2012) to determine the existence of a life cycle network. It classifies a network as a life cycle network if it meets the following six criteria:

1. Supports life cycle approaches and/or mentions LCA or life cycle thinking in the mission and vision statement
2. Includes, as a minimum, members from academia and industry or authorities, consultancies, NGOs (here we deviate from the original point made by Bjørn et al (2012) by allowing also networks without industry partners to be a life cycle network)
3. Is non-profit and hence uses revenues to achieve its goals rather than to distribute them as profit or dividends
4. Is based on some degree of central control and coordination
5. Embodies a communication platform to connect all the members (e.g. newsletter, web site, etc.)
6. Is stronger if it is an independent entity and not merely a subject specific subchapter of a larger LCA or Sustainable Consumption and Production (SCP) network (here we deviate again from Bjørn et al (2012) by not making the fact of having an independent entity part of the network definition but only a strengthening aspect and by extending the larger networks to include SCP).

The global survey carried out in 2014 covered a number of questions to determine the status of mainstreaming life cycle approaches at the country level. It asked participants about the existence, type and activities of national life cycle networks, the existence or plans to develop databases and the related funding needed for setting one up. These questions were inspired by the pioneering work done by Sagisaka (2004) from AIST, Japan, to ensure comparability.

Comparing the global survey results obtained in 2014 with those obtained by Sagisaka in 2004, it becomes apparent that life cycle approaches have started to become mainstreamed around the world. While at the very beginning of the 21st century LCA was still a topic which was promoted by a relatively small group of experts mostly from Europe, North America, Australia, Japan and South Korea, the level of maturity of

life cycle related activities and the actors behind them has clearly and positively evolved around the world since then. LCA training and workshops are offered in significantly more countries, consultancy services are increasingly present, more national networks exist and more national databases have been or are being planned to be developed.

At the national level, the survey indicated that for example China and Thailand as well as Brazil and Mexico are a bit ahead of their regional neighbours with regards to mainstreaming life cycle approaches, when we take into consideration for example the availability and quality of LCA trainings or studies.

Of the countries within the scope of the survey, we noticed that only the Philippines, Egypt, Morocco, Saudi Arabia and Russia do not have a national life cycle network. While several EU member states also do not have their own national network, these countries clearly benefit from efforts undertaken at the European Union level.

While it is thus positive to conclude that many countries actually do have a network, the picture changes significantly when taking into account each network's activity level. According to the survey results, participants only considered those activities of networks in Australia, France, Japan and the United States as being very active. These are also among the networks who organize annual or biannual life cycle conferences and are organised as legal entities within their country. They are also the ones which have been able to attract most members, which can be considered a result of their higher level of activity in comparison to other networks around the world.

## LCI Database Mapping

In addition to assessing the status of life cycle networks around the world, the survey also made an effort to assess and map Life Cycle Inventory (LCI) databases. As a result, a total of 23 databases have been identified. Of these 23 databases, 4 national databases are in the Americas, 4 in Asia/ Pacific and 4 in Europe. In addition, 2 European databases exist as well as 5 databases which are run by private-public partnership institutions and 4 by private consultancies (see Table 3, p. 54). The mapping shows the dynamic character of the LCA database development at the moment worldwide. However, a particularly strong development has happened so far in Europe.

It is interesting to note the general relationship between countries with a life cycle network and a national database. It appears that having a national life cycle network with a certain maturity which is organized as a legal entity significantly enhances the probability of creating a national LCA database, as most of the countries that have a network with a legal entity, for example Australia, France and the United States, also have a national LCA database. Only in a few cases, such as in Chile and Switzerland, has the national database been developed independently from the national network. In addition, countries without a life cycle network usually also don't have a plan to develop a LCA database, with the exception of Russia.

## Opportunities & Recommendations

Taking into account the conclusion that national life cycle networks can be considered a significant factor in promoting life cycle approaches on a national level, and enhance the chance of developing a national life cycle database, a number of recommendations and opportunities for the creation of these networks have been identified:

- In Egypt, Morocco, Philippines and Saudi Arabia as well as Turkey, outreach events

could be organised to start a process that could support the creation of a national life cycle network in each of these countries. In this context one could, for example, work together with ISO, which is organizing LCA trainings in the Middle East and North Africa (MENA) region.

- New networks should be build around a set of guiding principles for setting up and managing life cycle networks, which have been developed as part of this report and focus on the following key elements: Transparency, Governance, Inclusiveness & Balance, Purpose - Vision/ Mission, Life cycle approaches as core business, Quality control, Co-operation with other networks.
- The mainstreaming momentum of life cycle approaches in certain countries, as documented by the positive answers to most survey questions (e.g. Argentina, Brazil, Thailand and Mexico) could also be used for strengthening existing, or creating new life cycle networks in their respective regions, following the Anchor Countries approach to Global Development defined by the German Government (BMZ 2015). In the same way, efforts focusing on Saudi Arabia could also cover other countries in the Gulf region.
- Fact-finding missions supported by UNEP, UNIDO and other relevant international organizations could carry out awareness-raising on life cycle thinking and seek out potential national-level pioneers for promoting life cycle approaches in world regions that are currently missing such networks (i.e. Africa, Middle East and the post-Soviet states). Possible starting points could be Rwanda in Africa and Turkey for the Middle East, where training has already been conducted.

The survey has also provided important information on a number of countries (Argentina, Peru, India, Russian Federation, South Africa, Turkey and Indonesia) that are currently planning to develop their own national LCA databases. The efforts in these countries should be supported by providing:

- Training on the Global Guidance Principles for LCA Databases, also known as the Shonan Guidance Principles (Sonnemann and Vigon 2011). The principles represent a global consensus on database development and training could ensure that the new databases are compliant to the principles. The training could also be followed by a roadmap exercise on the way to establish the actual database.
- Technical assistance that could have the form of a limited number of Life Cycle Inventories (LCIs) of core products placed in the public domain to kick-start the development of a national LCA database in a consistent way.

Beyond helping the development of national networks and databases, a number of opportunities to grow and strengthen national life cycle networks, especially in emerging economies, have been identified:

- Outreach efforts to national business and industry stakeholders could help create the demand for life cycle based information, which ultimately would generate the motivation for a national LCA database.
- Supporting existing or new networks towards establishing a legal entity also appears to be a useful way to ensure that more regular activities take place and that a national database is developed. Even if local conditions were to provide obstacles to the creation of a legal entity, some sort of formalization of a network seems desirable as one can conclude from the survey that stronger networks, especially those backed by a legal entity, also provide a higher level of activity.

This means that multiple options exist to build and strengthen networks through adequate actions, such as through the provision of trainings and relevant material and experiences. In order to make this happen, seed funding is required, which could also come from international donors.

Finally, in those countries where databases already exist, these databases could become the lighthouses for other LCA database efforts

around the world, if they were supported as much as possible. To this end, both creators of new databases and those managing existing ones, could be offered training on the Shonan Guidance Principles. In addition, technical support could be provided for instance by helping in the review of pre-existing datasets, which is usually an expensive exercise if international LCA experts are to be engaged to increase the credibility of the database.

## Conclusion

The survey and this report show that life cycle approaches and concepts are increasingly applied globally; and new networks, stakeholders and national life cycle databases are emerging not only on a national, but also on an international level.

The national life cycle networks need to be supported to enable them to become a key driver in mainstreaming life cycle approaches and thinking in their respective countries and regions. The more active they become, the more likely is the creation of a national database, which is needed to support decision-makers on national and global level in policy and business contexts with reliable life cycle based information.

Beyond the national level, efforts on the international level are focusing increasingly on the question of database interoperability. To this end, the Global Network of Interoperable Databases (see 1.3.2) is currently working on identifying a process that could lead to a better exchange of data between different databases.

Through the implementation of the recommendations in this document, the authors expect that more life cycle networks and databases can be established and existing ones can be consolidated in support of more sustainable consumption and production worldwide, but particularly in emerging and developing economies.

# Resumé


Au cours des deux dernières décennies, des approches et des outils dédiés au cycle de vie (voir définitions dans 1.2 « Approches et concepts du cycle de vie ») ont été développés et affinés et sont devenus monnaie courante dans le secteur privé et public. Alors que l'intégration dans le marché de la notion du cycle de vie reste un effort continu, les approches du cycle de vie sont déjà en train de stimuler et soutenir la transition vers une économie verte.

Parmi d'autres, l'Initiative du Cycle de Vie de l'UNEP/SETAC a été un acteur clé pour favoriser le développement d'approches du cycle de vie et promouvoir leur application à l'échelle mondiale. Dans le cadre de leur projet phare 2a sur « Les données et la gestion des bases de données », une enquête mondiale a été réalisée en 2014 pour évaluer l'état des réseaux dédiés au cycle de vie et du développement des bases de données « Analyse du Cycle de Vie (ACV) » dans le monde. Ce rapport donne un aperçu des résultats de l'enquête, qui ont été développés grâce à des consultations avec des experts sur différents aspects régionaux.

Le sondage a été principalement distribué via la liste de diffusion mondiale de l'Initiative du Cycle de Vie de l'UNEP/SETAC, qui compte plus de 2500 abonnés, dont plus de 10% ont participé à l'enquête. En raison de leur importance économique et politique, le rapport se concentre en particulier sur les pays du G20 et la Suisse, ainsi que sur les pays qui ne sont pas dans le groupe du G20 mais où une dynamique de promotion des approches du cycle de vie a été identifiée (comme par exemple la Thaïlande).

## Réseaux dédiés au cycle de vie

L'enquête a utilisé la définition par Bjørn et al (2012) pour déterminer l'existence d'un réseau dédié au cycle de vie. Elle classe un réseau en tant que réseau dédié au cycle de vie si le réseau répond aux six critères suivants :

1. Soutient les approches du cycle de vie et/ou mentionne l'ACV ou la notion de cycle de vie dans l'énoncé de sa mission et de sa vision
2. Comprend, à minima, des membres (1)du milieu universitaire et aussi (2) de l'industrie, des autorités gouvernementales, des consultants, ou des ONG (ici nous nous écartons de la définition d'origine faite par Bjørn et al (2012) en permettant également aux réseaux sans partenaires industriels d'être considérés comme un réseau dédié au cycle de vie)
3. Est à but non-lucratif et utilise donc ses recettes pour atteindre ses objectifs plutôt que de les distribuer sous forme de profit ou de dividendes
4. Est basé sur un certain degré de contrôle central et de coordination
5. Comporte une plate-forme de communication permettant de connecter tous les membres (par exemple, un bulletin d'information, un site web, etc.)
6. Est plus fort si il indépendant et non pas un sous-chapitre d'un réseau plus grand sur l'ACV ou la consommation et la production durables (CPD) (ici nous nous écartons à nouveau de Bjørn et al (2012) en n'incluant pas dans la définition de réseau le fait d'être une entité indépendante, mais seulement un aspect de renforcement, et en étendant les réseaux plus grands incluant la notion de CPD).

L'enquête mondiale réalisée en 2014 a porté sur un certain nombre de questions afin de déterminer l'état de l'intégration dans le marché des approches du cycle de vie au niveau des pays. Les questions posées aux participants portaient sur l'existence, le type et les activités des réseaux nationaux dédiés au cycle de vie, l'existence ou les projets de développement de bases de données et les financements nécessaires à leur mise en place. Ces questions ont été inspirées par le travail de pionnier accompli par Sagisaka (2004) de l'AIST au Japon.

En comparant les résultats globaux de l'enquête obtenus en 2014 avec ceux obtenus par Sagisaka en 2004, il devient évident que les approches du cycle de vie ont commencé à se généraliser dans le monde entier. Alors qu'au début du 21e siècle l'ACV était encore un sujet promu par un groupe relativement restreint d'experts provenant principalement d'Europe, d'Amérique du Nord, d'Australie, du Japon et de la Corée du Sud, le niveau de maturité des activités liées au cycle de vie et leurs acteurs ont clairement et positivement évolué dans le monde entier depuis. Des formations et des ateliers sur l'ACV sont proposés dans beaucoup plus de pays, les services de conseil sont de plus en plus présents, davantage de réseaux nationaux existent et de nombreuses bases de données nationales ont été développées ou sont en cours de planification.

Au niveau national, l'enquête a indiqué que la Chine et la Thaïlande par exemple, ainsi que le Brésil et le Mexique sont en avance sur leurs voisins régionaux en ce qui concerne l'intégration des approches du cycle de vie dans le marché. Ceci est demontré, par exemple, par la disponibilité et la qualité des formations ou des études sur l'ACV.

Parmi les pays pris en compte dans l'enquête, nous avons remarqué que seuls les Philippines, l'Egypte, le Maroc, l'Arabie Saoudite et la Russie ne disposent pas d'un réseau national sur le cycle de vie. Alors que plusieurs Etats membres de l'UE n'ont pas non plus leur propre réseau national, ces pays bénéficient néanmoins des efforts entrepris au niveau de l'Union Européenne.

Alors que nous pouvons positivement conclure que dans de nombreux pays un réseau existe, l'image change de manière significative si l'on tient compte du niveau d'activité de chaque réseau. Selon les résultats de l'enquête, les participants considèrent uniquement les réseaux en Australie, en France, au Japon et aux États-Unis comme étant très actif. Ce sont aussi des réseaux qui organisent tous les ans ou tous les deux ans des conférences sur le cycle de vie et sont organisés comme des entités juridiques au sein de leur pays. Ce sont également les réseaux qui ont su attirer le plus grand nombre de membres, ce qui peut être considéré comme un résultat de leur niveau d'activité supérieur aux autres réseaux du monde.

## Cartographie des bases de données « ICV »

En plus d'évaluer l'état des réseaux dédiés au cycle de vie dans le monde, l'enquête a également évalué et cartographié les bases de données « Inventaire du Cycle de Vie (ICV) ». Par conséquent, un total de 23 bases de données a été identifié. Sur ces 23 bases de données, 4 bases de données nationales sont dans les Amériques, 4 en Asie/Pacifique et 4 en Europe. En outre, 2 bases de données européennes existent ainsi que 5 bases de données gérées par des institutions de partenariat public-privé et 4 par des sociétés de conseil (voir Tableau 3, p. 54). La cartographie montre le caractère dynamique du développement des bases de données « ACV » en ce moment dans le monde entier. Cependant, un développement particulièrement fort est arrivé à ce jour en Europe.

En comparant les pays, il est intéressant de noter la corrélation entre la présence d'un réseau dédié au cycle de vie et une base de données nationale. Il semble que la présence d'un réseau national dédié au cycle de vie ayant une certaine maturité et organisé comme une entité juridique améliore considérablement la probabilité de créer une base de données nationale « ACV ». En effet, la plupart des pays ayant un réseau avec une entité juridique, par exemple en Australie, France et aux États-Unis, ont également une base de données nationale « ACV ». Dans quelques rares cas, comme au Chili et en Suisse, la base de données nationale a été développée indépendamment du

réseau national. En outre, les pays n'ayant pas de réseau dédié au cycle de vie n'ont pas non plus de plan pour développer une base de données « ACV », à l'exception de la Russie.

## Possibilités et recommandations

Compte tenu de la conclusion que les réseaux nationaux dédiés au cycle de vie peuvent être considérés comme un facteur important dans la promotion des approches du cycle de vie au niveau national, et ont la capacité d'améliorer les chances de développer une base de données du cycle de vie nationale, un certain nombre de recommandations et de possibilités pour la création de ces réseaux a été identifié :

- En Egypte, au Maroc, aux Philippines et en Arabie Saoudite, ainsi qu'en Turquie, des activités de sensibilisation pourraient être organisées pour commencer un processus visant à soutenir la création d'un réseau dédié au cycle de vie national dans chacun de ces pays. Dans ce contexte, on pourrait, par exemple, travailler en collaboration avec l'ISO, qui prévoit d'organiser des formations sur l'ACV dans la région Moyen-Orient et Afrique du Nord (MOAN).
- Les nouveaux réseaux devraient être construits autour d'un ensemble de principes directeurs pour la mise en place et la gestion des réseaux dédié au cycle de vie, qui ont été développés dans le cadre de ce rapport et se concentrent sur les éléments clés suivants : Transparence, Gouvernance, Intégration & Equilibre, Objectif - vision / mission, les approches du cycle de vie comme cœur de métier, Contrôle de la qualité, Coopération avec d'autres réseaux.
- Le dynamisme général des approches du cycle de vie dans certains pays (démontré par les réponses positives à la plupart des questions d'enquête) comme l'Argentine, le Brésil, la Thaïlande et le Mexique, pourrait également être utilisé pour créer un réseau dédié au cycle de vie dans leurs régions respectives, suite à l'approche des pays « ancre » pour un développement global définie par le gouvernement allemand (BMZ 2015). De la même manière, les efforts axés sur l'Arabie Saoudite pourraient également couvrir d'autres pays de la région du Golfe.
- Des missions d'enquête pourraient être financées pour mener à bien la sensibilisation sur la notion de cycle de vie. Il serait ainsi possible d'identifier les pionniers dans la promotion des approches du cycle de vie dans les régions du monde où de tels réseaux manquent à l'heure actuelle, à savoir l'Afrique, le Moyen-Orient et les Etats post-soviétiques. Cela pourrait, par exemple, être le Rwanda en Afrique et la Turquie au Moyen-Orient, où des formations ont déjà été menées dans le passé.

L'enquête a également fourni des informations importantes sur un certain nombre de pays (Argentine, Pérou, Inde, Fédération de Russie, Afrique du Sud, Turquie et Indonésie) qui envisagent de développer leurs propres bases de données « ICV » nationales. Les efforts de ces pays devraient être soutenus en fournissant les éléments suivants:

- Formation sur les lignes directrices mondiales pour les bases de données d'ACV), aussi connues sous le nom de lignes directrices de Shonan (Sonnemann et Vigon 2011). Ces principes représentent un consensus mondial sur le développement des bases de données. Ainsi, cette formation permettrait d'assurer la conformité vis-à-vis de ces principes. Elle pourrait également être suivie d'un exercice de feuille de route sur la façon de développer la base de données.
- L'assistance technique qui pourrait avoir la forme d'un nombre limité d'inventaires du cycle de vie (ICV) des produits de base placés dans le domaine public pour lancer le développement d'une base de données « ACV » nationale d'une manière cohérente.

En plus d'aider au développement des réseaux et des bases de données nationaux, un certain nombre d'opportunités de croissance et de renforcement des réseaux nationaux dédiés au cycle de vie, en particulier dans les économies émergentes, ont été identifiées :

- Les efforts de sensibilisation auprès des entreprises et des industries nationales pourraient aider à générer la demande en informations basées sur le cycle de vie, ce qui inciterait la création de bases de données “ACV” nationales.
- Soutenir les réseaux existants ou nouveaux en vue d’établir une entité juridique semble également être un moyen utile pour assurer la régularité des activités et le développement d’une base de données nationale. Même si les conditions locales présentent des obstacles à la création d’une entité juridique, la formation des réseaux est souhaitable. . Effectivement, les résultats de l’enquête montrent que ce sont les réseaux les plus solides, et en particulier ceux soutenus par une entité juridique, qui fournissent un niveau d’activité plus élevé.

Cela signifie que plusieurs options existent pour construire et renforcer les réseaux à travers des actions appropriées, notamment par l’offre de formations, de documents et de retours d’expérience pertinents. Pour ce faire, un financement initial pouvant provenir de donateurs internationaux est nécessaire.

Enfin, dans les pays où des bases de données existent déjà, celles-ci pourraient devenir « phares » pour d’autres efforts de base de données « ACV » dans le monde entier, si ces actions étaient soutenues autant que possible. A cette fin, les créateurs de nouvelles bases de données et les gestionnaires de celles qui existent déjà pourraient recevoir une formation sur les lignes directrices de Shonan. En outre, un soutien technique pourrait être fourni par exemple en aidant à la revue des ensembles de données préexistants, ce qui est un exercice coûteux si des experts internationaux de l’ACV doivent être engagés pour accroître la crédibilité de la base de données.

# Conclusion

L’enquête et ce rapport montrent que les approches et les concepts du cycle de vie sont de plus en plus appliqués à l’échelle mondiale ; et des nouveaux réseaux, intervenants et bases de données du cycle de vie nationales émergent, non seulement sur le plan national mais aussi au niveau international.

Les réseaux nationaux dédiés au cycle de vie doivent être soutenus afin de leur permettre de devenir un facteur clé dans l’intégration des approches et de la notion de cycle de vie dans leurs zones géographiques respectives. Plus ils deviendront actifs, plus il y aura de chances de création de bases de données nationales, ce qui est nécessaire pour aider les décideurs au niveau national et mondial dans les domaines de la politique et des affaires avec des informations fiables basées sur l’analyse du cycle de vie.

Au-delà du niveau national, des efforts sur le plan international se concentrent de plus en plus sur la question de l’interopérabilité des bases de données. A cette fin, le réseau mondial des bases de données interopérables (voir 1.3.2) travaille actuellement sur l’identification d’un processus qui pourrait conduire à un meilleur échange de données entre les différentes bases de données.

Grâce à la mise en œuvre des recommandations contenues dans le présent document, les auteurs prévoient que plus de réseaux dédiés au cycle de vie et bases de données seront établis et que les réseaux et bases de données existants seront consolidés à l’appui de la consommation et de la production plus durables dans le monde entier, mais en particulier dans les pays émergents et en voie de développement.

# Resumen Ejecutivo

En las dos últimas décadas, los enfoques y herramientas de ciclo de vida (ver definiciones en 1.2 'Enfoques y Conceptos de Ciclo de Vida') se han desarrollado, refinado y convertido en más comunes en los sectores público y privado. Si bien la incorporación del pensamiento de ciclo de vida aún requiere esfuerzos, los enfoques de ciclo de vida ya están estimulando y apoyando la transición hacia una economía verde.

Entre otros actores, la Iniciativa de Ciclo de Vida de PNUMA/SETAC ha sido un factor clave para fomentar el desarrollo de los enfoques de ciclo de vida y promover su aplicación a nivel mundial. Como parte de su proyecto bandera 2a acerca de "Datos y manejo de bases de datos", en el 2014 se llevó acabo una encuesta global para evaluar el estado de las redes de ciclo de vida y el desarrollo de bases de datos de análisis ciclo de vida (ACV) en todo el mundo. Este reporte brinda una visión general de los resultados de la encuesta, el cual fue complementado con aportes de expertos en diferentes aspectos regionales.

La encuesta fue distribuida a través de la lista global de distribución de la Iniciativa de Ciclo de Vida de PNUMA/SETAC, que tiene más de 2500 suscriptores, de los cuales más del 10% participaron en la encuesta. Debido a su relevancia económica y política, el informe se enfoca principalmente en los países dentro del grupo G20 más Suiza, así como los países objetivo de la Unión Europea que no están incluidos dentro del grupo G20, donde se ha identificado que actualmente hay un dinamismo en la promoción de los enfoques de ciclo de vida (por ejemplo, en Tailandia).

## Redes de Ciclo de Vida

La encuesta empleó la definición de Bjørn et al. (2012) para determinar la existencia de una red de ciclo de vida. Bjørn clasifica a una red de ciclo de vida si cumple los siguientes seis criterios:

1. Apoya los enfoques de ciclo de vida y/o menciona ACV o el pensamiento de ciclo de vida en la misión y visión.
2. Incluye, como mínimo, a miembros de la academia como de la industria o a autoridades, consultoras y ONGs (aquí nos desviamos del concepto original establecido por Bjørn et al. (2012), permitiendo a redes sin socios de la industria ser consideradas redes de ciclo de vida).
3. Es sin fines de lucro y por lo tanto emplea los ingresos para lograr sus objetivos en lugar de distribuirlos como ganancias o dividendos.
4. Cuenta con cierto grado de coordinación y control central.
5. Encarna una plataforma de comunicación que permite conectar a todos los miembros (por ejemplo, a través de notas de prensa, pagina web, etc.).
6. Es más sólida si se trata de una entidad independiente y no sujeta a específicamente a un subcapítulo de una red más grande de ACV o de Consumo y Producción Sostenible (SCP por sus siglas en inglés) (aquí nos desviamos otra vez del concepto original establecido por Bjørn et al. (2012), al no considerar el hecho de contar con una entidad independiente como un requisito pero como un aspecto para el fortalecimiento de la red, y al mencionar a redes de SCP entre las posibles redes más grandes que la pudiesen absorber).

La encuesta global realizada en el 2014 cubrió una serie de preguntas para determinar el estado de la incorporación del enfoque de ciclo de vida a nivel país. Se preguntó a los participantes sobre la existencia, tipo y actividades de las redes de ciclo de vida, la existencia o planes para desarrollar bases de datos y el financiamiento necesario para establecer dichas bases de datos. Estas interrogantes se inspiraron en el trabajo pionero realizado por Sagisaka (2004) del IST, Japón, para asegurar la comparabilidad.

Comparando los resultados de la encuesta global obtenidos en el 2014 con los reportados por Sagisaka en el 2004, es evidente que los enfoques de ciclo de vida han comenzado a ser incorporados en todo el mundo. Mientras que a inicios del siglo 21, el ACV aún era un tópico que era promovido por un grupo relativamente pequeño de expertos mayormente provenientes de Europa, Norteamérica, Australia, Japón y Corea del Sur, el nivel de madurez de las actividades relacionadas con el ciclo de vida y de los actores detrás de las actividades ha evolucionado desde entonces de manera clara y positiva en todo el mundo. Los talleres y capacitaciones en ACV son ofrecidos en un número significativo de países, los servicios de consultoría están cada vez más presentes, existen más redes nacionales y más bases de datos nacionales han sido desarrolladas o se piensa desarrollar.

A nivel nacional, la encuesta reportó que, por ejemplo, China y Tailandia, así como Brasil y México están un poco más adelantados que sus vecinos de la región con respecto a la incorporación de los enfoques de ciclo de vida, si tomamos en consideración la disponibilidad y calidad de los estudios o cursos de formación en ACV.

Entre los países encuestados, notamos que sólo Filipinas, Egipto, Marruecos, Arabia Saudita y Rusia no tienen una red nacional de ciclo de vida. Por otro lado, aunque varios países miembros de la Unión Europea no poseen su propia red nacional, estos países se benefician claramente de los esfuerzos realizados a nivel de la Unión Europea.

Si bien es positivo concluir que muchos países actualmente cuentan con una red, la figura cambia significativamente cuando se trata del nivel de actividad de cada red. De acuerdo con los resultados de la encuesta, sólo los participantes de las redes en Australia, Francia, Japón y los Estados Unidos consideraron sus redes como muy activas. Además las redes de estos países están entre las que realizan conferencias de ciclo de vida anuales o bianuales y están organizadas como entidades legales dentro de su país. Estas redes también han sido capaces de atraer muchos miembros, lo que puede ser atribuido a su alto nivel de actividad en comparación con otras redes del mundo.

## Mapeo de Bases de Datos en Inventarios de Ciclo de Vida (ICV)

Además de evaluar el estado de las redes de ciclo de vida alrededor del mundo, la encuesta también realizó un esfuerzo para evaluar y mapear las bases de datos en Inventarios de Ciclo de Vida (ICV). Como resultado, se han identificado un total de 23 bases de datos. De estas 23 bases de datos, 4 se encuentran en América, 4 en Asia/Pacífico y 4 en Europa. Adicionalmente, existen 2 bases de datos europeas, así como 5 bases de datos a cargo de partenariados público-privados y 4 a cargo de consultores privados (ver Tabla 3, p. 54). El mapeo muestra el carácter dinámico del desarrollo de las bases de datos de ICV en el mundo. Sin embargo, se registra particularmente un gran desarrollo en Europa.

Es interesante notar en países con una red de ciclo de vida y una base de datos, la relación general entre ambos. Al parecer, contar con una red de ciclo de vida con cierta madurez que está organizada como una entidad legal, incrementa significativamente la probabilidad de crear una base de datos ACV nacional, como en los casos de Australia, Francia y los Estados Unidos, que tienen una persona jurídica y una base de datos ACV nacional. Sólo en pocos casos, como en Chile y Suiza, la base de datos nacional es desarrollada de manera independiente de la red nacional. Además, típicamente, los países sin una red de ciclo de vida, no poseen planes para desarrollar una base de datos ACV, excepto Rusia.

# Oportunidades & Recomendaciones

Tomando en cuenta que las redes nacionales de ciclo de vida pueden ser consideradas como un factor significativo en la promoción de los enfoques de ciclo de vida a nivel nacional, y pueden mejorar las posibilidades de desarrollo de una base de datos de ciclo de vida, se han identificado un número de recomendaciones y oportunidades para la creación de estas redes:

- En Egipto, Marruecos, Filipinas y Arabia Saudita, así como en Turquía, se podrían organizar eventos de divulgación para iniciar el proceso que apoye a la creación de una red nacional de ciclo de vida en cada uno de estos países. En este contexto se podría, por ejemplo, trabajar en conjunto con ISO, el cual está organizando actividades de capacitación en ACV en el Oriente Medio y el Norte de África (MENA).
- Las nuevas redes se deberían construir en torno a un conjunto de principios rectores para la creación y gestión de redes de ciclo de vida, las cuales se han desarrollado como parte de este informe e incluyen los siguientes elementos clave: Transparencia, Gobernabilidad, Inclusión & Equilibrio, Propósito-Visión/Misión, Enfoque de ciclo de vida como actividad central, Control de calidad, Cooperación con otras redes.
- El mayor dinamismo en la incorporación del pensamiento de ciclo de vida en ciertos países como en Argentina, Brasil, Tailandia y México, según las respuestas positivas a la mayor parte de las preguntas, podría ser utilizado para la creación de una red regional de ciclo de vida en sus respectivas regiones, siguiendo el enfoque de países ancla para el desarrollo global definido por el Gobierno de Alemania (BMZ 2015). De la misma manera, los esfuerzos que se están concentrando en Arabia Saudita podrían abarcar otros países de la región del Golfo.
- Se pueden financiar misiones de reconocimiento a fin de sensibilizar en el pensamiento de ciclo de vida y para comenzar a identificar a aquellos que podrían ser pioneros en la promoción del enfoque de ciclo de vida en regiones del mundo con una mayor ausencia de redes, como por ejemplo en África, Medio Oriente y los estados post Unión Soviética. Las misiones de reconocimiento podrían incluir países como Ruanda en África y Turquía para el Oriente Medio, donde las capacitaciones ya se han realizado en el pasado.

La encuesta también ha brindado información importante acerca de un número de países (Argentina, Perú, India, Federación Rusa, Sudáfrica, Turquía e Indonesia) que están planeando desarrollar sus propias bases de datos ACV nacionales. Los esfuerzos en estos países deberían ser apoyados a través de:

- Capacitación acerca de los Principios Guía Globales para Bases de Datos de ACV, también conocidos como los Principios Guía Shonan (Sonnemann y Vigon 2011). Los Principios Guía Shonan representan un consenso global en el desarrollo de las bases de datos y la capacitación debe asegurar que las nuevas bases de datos cumplan con estos principios. La capacitación también podría ser seguida por un ejercicio de hoja de ruta hacia el establecimiento de una base de datos.
- Asistencia Técnica que podría tener la forma de un número limitado de Inventarios de Ciclo de Vida (ICV) de productos principales colocados en el dominio público para iniciar el desarrollo de una base de datos ACV nacional de manera consistente.

Además de apoyar al desarrollo de redes y bases de datos nacionales, también se han identificado una serie de oportunidades de crecimiento y fortalecimiento de las redes nacionales de ciclo de vida especialmente en economías emergentes:

- Los esfuerzos de divulgación a las partes interesadas empresariales e industriales nacionales podrían ayudar a crear la demanda de información basada en el ciclo de vida, que en última instancia generaría la motivación para una base de datos nacional de ACV.

- El apoyo a las redes existentes o nuevas mediante el establecimiento de una entidad legal también parece ser una forma útil de asegurar que actividades mas regulares se lleven a cabo y que se desarrolle una base de datos nacional. Incluso si las condiciones locales presenten obstáculos para la creación de una persona jurídica, se considera conveniente algún tipo de formalización de la red pues se pudo concluir de la encuesta que redes más fuertes, especialmente aquellos respaldados por una persona jurídica, también registran un mayor nivel de actividad.

Esto significa que existen varias opciones para construir y fortalecer las redes mediante acciones adecuadas, como la provisión de capacitación y material y experiencias relevantes. Para que esto ocurra, se requiere de un fondo semilla, que podría provenir de donantes internacionales.

Finalmente, en aquellos países donde ya existen bases de datos, éstas pueden servir de guía e inspiración para otros esfuerzos de bases de datos de ACV en el mundo, en tanto que se les de todo el apoyo posible. Para este fin, se podría ofrecer capacitación acerca de los Principios Guía Shonan a los creadores de nuevas bases de datos y a los administradores de las existentes. Adicionalmente, se puede brindar soporte técnico, por ejemplo, para la revisión de las bases de datos preexistentes, que generalmente es una actividad costosa si se contrata a expertos ACV a fin de incrementar la credibilidad de la base de datos.

## Conclusión

La encuesta y este reporte muestran que los enfoques y conceptos de ciclo de vida se están aplicando globalmente, y que nuevas redes, partes interesadas y bases de datos nacionales de ciclo de vida están emergiendo no solo a nivel nacional, sino también en el contexto internacional.

Las redes de ciclo de vida nacionales necesitan contar con apoyo para permitirles convertirse en el motor clave en la incorporación del enfoque y pensamiento de ciclo de vida en sus respectivas geografías. Mientras más activas sean, más probable será la creación de una base de datos nacional, que es necesaria para apoyar la toma de decisiones a nivel nacional y global en contextos políticos y empresariales con información confiable basada en el ciclo de vida.

Más allá del nivel nacional, los esfuerzos a nivel internacional se están enfocando cada vez mas en la interoperabilidad de las bases de datos. Con este fin, la Red Global de Bases de Datos Interoperables (ver 1.3.2) está trabajando en identificar un proceso que pueda conducir a un mejor intercambio de datos entre las diferentes bases de datos.

Con la implementación de las recomendaciones vertidas en este documento, se espera que se establezcan más redes de ciclo de vida así como bases de datos, y que las redes y bases de datos existentes puedan consolidarse hacia un mayor consumo y producción sostenibles a nivel mundial, pero particularmente en las economías emergentes y en desarrollo.

# 执行摘要

在过去二十年内，生命周期思想和工具已经广泛应用于私营部门和公共部门。虽然将生命周期思想主流化仍然需要诸多努力，但这一概念已经逐渐支持和促进了向绿色经济的转变。

在许多的开创者中，由联合国环境规划署与环境毒理与化学协会所建立的生命周期倡议计划（the UNEP/SETAC Life Cycle Initiative），项目组在全球范围内推广和使用生命周期理念和方法起到了决定性的作用。作为该倡议计划的数据和数据库管理旗舰项目，在2014年发起了全球范围内的调查，评估生命周期网络和生命周期评价数据库在全球的发展情况。本报告总结了基于这个调查和对各个地区专家的咨询结果。

本调查主要通过联系“生命周期倡议计划”全球邮件名录的2500名注册用户来获取信息，其中超过10%的用户给与了反馈。基于经济和政策的相关性，本报告主要集中在G20国家和其他一些在发展生命周期评价工作有较大贡献的国家（比如瑞士），以及一些未被G20涵盖的目标国家（例如泰国）。

## 生命周期网络

本调查采用了Bjørn et al (2012)文献中对于生命周期网络的定义。该文献采用了以下六个标准来定义生命周期网络：

在工作目标和方针中明确支持生命周期思想或者生命周期评价

成员至少涵盖学术界、工业界或政府、咨询行业、非政府组织（我们的定义和文献略有不同，我们允许生命周期网络没有工业界的成员）

非营利性：将收入用于实现其工作目标而非为了营利

基于某种程度的集中控制和协调工作

拥有交流平台来联合其会员（定期新闻更新、网站等）

作为独立的实体单位，而不仅仅是一个大型生命周期网络或者可持续消费生产网络的分支（这里的定义和文献不同，强调该网路是一个独立实体单位，而不是其他网络的附属网络）

2014年的全球调查主要考查在国家层面推广生命周期思想的实施情况。调查询问了是否存在国家生命周期网络，以及其类型、活动、开发生命周期数据库以及需要建立数据库的资金。这些问题是受到了日本产业技术综合研究所Sagisaka (2004)文献的启发，从而方便国家间的对比。

通过对比Sagisaka (2004)文献和2014年的全球调查，结果显示生命周期思想已经在全球范围内逐渐被主流化。在21世纪初，生命周期评价仅在欧洲、北美、澳大利亚、日本和韩国，被小规模的专家组所倡导；之后，生命周期相关的活动和成员在全球范围内不断成熟和进化。生命周期评价相关的培训和研讨会在很多国家举办，相关咨询服务不断涌现，逐渐出现了更多的生命周期网络，国家层面的生命周期数据库已经或者正在被开发。

调查显示，考虑到生命周期评价的培训和研究的质量，在国家层面将生命周期思想主流化的程度，中国、泰国、巴西和墨西哥略微领先同区域其他国家。

在调查的国家当中，只有菲律宾、埃及、摩洛哥、沙特阿拉伯和俄罗斯没有国家级的生命周期网络。虽然一些欧盟国家没有自己的国家网络，但是他们很明显的受惠于整个欧盟层面的工作。

虽然很多国家拥有生命周期网络，但如果考虑到网络的具体活动和工作内容，情况则有很大差异。调查结果显示，调查参与者仅认为澳大利亚、法国、日本和美国的网络很活跃。这些网络通过国家层面的合法机构，组织每年或双年的生命周期会议。这些国家能够吸引多数的会员来参与更高层面的活动。

## 生命周期清单数据库的分布

除了评估全球生命周期网络的情况，本调查也涉及了评估生命周期清单数据库。结果显示一共有23个数据库。在这23个数据库中，四个国家级数据库在美洲，四个在亚太地区，四个在欧洲。同时，公共私营合作机构和私有咨询公司建立和运营了两个欧洲数据库和五个其他地区数据库（参见表3）。调查显示生命周期数据库目前在全球发展活跃，但主要进展主要来自欧洲。

在国家层面，生命周期网络和国家数据库之间有一定的相关性。调查显示，拥有一定成熟度的国家生命周期网络会促进国家数据库的建立。澳大利亚、法国和美国等国家拥有合法机构运营的国家生命周期网络，这些国家已经建立了生命周期评价数据库。仅仅存在少数的案例，例如智力和瑞士，没有依赖国家层面的生命周期网络来建立数据库。与此同时，没有生命周期网络的国家一般不拥有生命周期评价数据库，但俄罗斯除外。

## 机遇和建议

基于以上的结论，拥有国家层面生命周期网络对于推进生命周期思想、提高建立生命周期数据库的几率有重要作用。本报告针对建立这些网络提供了如下建议：

- 在埃及、摩洛哥、菲律宾、沙特阿拉伯、土耳其和印度尼西亚，可以开展更多的拓展活动来支持建立国家层面的生命周期网络。例如，可以同国际标准化组织合作，在中东和北非开展生命周期评价的培训。
- 建立新的网络需要基于一系列的原则，这些原则可以用于指导网络的管理：透明性、管理制度、包容度和平衡、目的目标、以生命周期思想为指导原则、质量控制、以及同其他网络合作。
- 一些国家推广生命周期思想的成果，可以作为建立该地区的区域网络的动力（例如在调查中提到的阿根廷、巴西、泰国和墨西哥，这些国家是被德国政府所确定的全球发展目标国家）。同时，在沙特阿拉伯推广的工作，也可以覆盖阿拉伯海湾地区。
- 在一些国家资助相关的调研工作，以提高应用生命周期思想的意识，有助于识别在国家层面开展开拓性工作的机构（例如非洲、中东和后苏维埃国家）。在非洲的卢旺达和中东的土耳其，过去都组织过类似的培训。

本调查也提供了一些正在计划建立生命周期数据库国家的情况（阿根廷、秘鲁、印度、俄罗斯、南非、土耳其和印度尼西亚）。对于这些国家的支持可以包括：

针对建立国家数据库的国家，进行全球生命周期评价数据库指导原则（Sonnemann and Vigon 2011）的培训。 这些经过全球研讨和达到共识的原则，可作为发展新数据库遵守的标准。培训之后通常可以为相应的国家制定建立数据库的路线计划。

针对公共领域的核心产品提供技术支持，准备有限数量的生命周期清单来引导建立国家层面数据库。

除了建立国家层面的网络和数据库，我们还提供了针对新兴经济体，增强国家网络的一些建议：

- 增强对工业界和企业的拓展工作，提高对基于生命周期信息的需求，最终促进建立国家生命周期评价数据库。
- 通过设立合法机构，支持现有或者建立新的网络，对建立国家数据库有推动作用。如果本地条件不支持建立合法机构来运行网络，对于生命周期网络一定程度上的正规化，特别是被合法机构支持，能推动更高层面的活动。
- 这意味着建立和增强网络有多种方法，例如增强培训和提供相关的材料和经验。为了实现这些方案，需要得到国际社会的资金支持。

在一些已有生命周期数据库的国家，这些数据库可以作为其他国家的样板。对于新建数据库的国家，以及已有数据库的国家，他们都可以接受关于全球生命周期评价数据库指导原则的培训。针对一些现有数据库，对其数据的审阅往往需要许多国际专家的参与并需要大量经费，这一方面也可以考虑提供技术支持。

## 结论

本次调查显示，生命周期思想在全球范围内不断得到应用。新兴生命周期网络、利益相关者和国家生命周期数据库不仅在国家层面，也在全球层面不断涌现。

为了将生命周期思想主流化，需要在不同地区，为国家层面的生命周期网络提供支持。这些网络开展的活动越多，建立国家数据库的可能性就越大，这可以为支持国家和全球政策和商业方面的决策者，提供可靠的基于生命周期思想的信息。

除了国家层面，在全球层面对于生命周期数据库之间的可交互性的要求越来越高。到目前为止，全球生命周期数据库交互网络（参考1.3.2）正在制定一个平台和机制，确保全球范围内，不同的生命周期数据库能够交互使用。

# 1. Introduction

This chapter introduces the objective, scope and motivation of the report. It also provides the global context of efforts to mainstream life cycle thinking in business practice and policies to change unsustainable consumption and production patterns and to increase resource efficiency. It also provides introductions to life cycle approaches and provides a quick overview of key international stakeholders.

## 1.1 Context, aim and scope of the report

The report was commissioned by the UNEP/ SETAC Life Cycle Initiative (see chapter 1.3.1), as part of its flagship project on Data and Database Management. The report seeks to contribute to the global dialogue around how to more efficiently and effectively operationalise sustainability efforts of the private sector as well as by governments.

Promoting life cycle thinking among decision makers and associated policymakers in product (goods and services) design and development is in this context intended to help implement resource-efficient business practices and sustainable consumption and production policies around the world. For these actors to become more familiar with the concept of life cycle thinking and information derived from LCAs, capacity building worldwide around life cycle thinking and management is equally important as enhancing the availability of LCA datasets, in particular in emerging economies.

The overall objective of the report is thus twofold: to provide a global status report on mainstreaming life cycle approaches in different world regions and countries; and to outline concrete recommendations and opportunities on how to support and enhance the mainstreaming of life cycle thinking around the world. To achieve these objectives, the analysis and recommendations will focus on the promotion of National Life Cycle Networks and National Life Cycle Assessment (LCA) Databases. Furthermore, the report contributes to the 10YFP Consumer Information Programme's aim to ensure the availability of comparable and good quality data to support consumer information for sustainable consumption. As a collaborative output of this programme, the report will be shared with, and used by, its stakeholder network.

As the overall objective of mainstreaming life cycle thinking is to enhance global sustainability efforts in the most impactful way, the geographical scope of this report is mainly on the G20 major economies, Switzerland and seven emerging and developing countries. G20 economies were considered due to their large share of the gross world product (85%) and of the world trade (80%), through which they contribute significantly to global resources consumption and associated environmental impacts. Switzerland has been taken into account due to the fundamental role that the Swiss Government and Swiss stakeholders have played at the international level in developing life cycle methodologies, databases and capacities.

Finally, following on the conclusions and recommendations of the international mapping done by Bjørn et al (2012) on focusing international efforts on emerging and rapidly growing economies, and taking into account European Union target countries not included in the G20 group, seven additional countries were considered in the sample: Egypt and Morocco from Africa, Malaysia, Philippines and Thailand from the Asia/ Pacific region and Chile and Peru from Latin America.

With this geographical scope, information on the situation of mainstreaming life cycle approaches and of existing and planned life cycle networks and databases is provided based on data of representative samples from the following world regions: Africa, Asia/ Pacific, Europe and Central Asia, Latin America and the Caribbean as well as North America.

## 1.2 Life Cycle Approaches and Concepts

### 1.2.1 Differentiation between life cycle thinking and quantitative sustainability assessment tools

The objective of Life Cycle Thinking is to guide the transition from a single step perspective to a holistic picture of an entire product or activity system. This approach is therefore meant to ensure that environmental improvements of products and services are achieved and the use of resources is reduced across all life cycle stages. Life cycle stages include raw material extraction and conversion and manufacturing and distribution, as well as the use and/or consumption phase of a product or service, and conclude with its end of life. Life Cycle Thinking thus reminds consumers and manufacturers of the fact that a product is associated with a series of activities along its entire life cycle.

Life cycle thinking is thus more focused on providing an understanding for the fact that in our modern world everything is interrelated and that it is important to consider impacts along the entire life cycle. Implementing life cycle thinking thus means to work with, or think of, the entire supply chain and to engage with different stakeholders, which can range from policy developers, to environmental managers, to product designers and engineers.

Quantitative sustainability assessment tools such as Life Cycle Assessment, described below, provide actual and scientifically backed information which can provide decision makers with concrete recommendations on how to reduce their product's or service's environmental impact. These tools, however, require quality data and appropriate methods in order to avoid burden shifting, where a supposed environmental enhancement in one stage of the life cycle is offset by a higher environmental impact in another life cycle phase.

### 1.2.2 Life Cycle Assessment according to ISO

Life Cycle Assessment (LCA) is a quantitative modelling exercise where a broad range of impacts of a product or service along its entire life cycle (i.e. from raw material extraction to end of use and re-use of the finished product) are assessed. The concept of LCA dates back to the 1980s when it emerged as a tool to better understand the risks, opportunities and trade-offs of product systems as well as the nature of environmental impacts. In 1993, the International Organization for Standardization (ISO) tasked a small group of LCA experts that were organized within the Society of Environmental Toxicology and Chemistry (SETAC) to develop a recommendation regarding the need to standardize LCA. Following this recommendation, by 1997 the ISO 14040:1997 standard for Life cycle assessment – Principles and framework had been completed.

The standardization process of LCA was a real challenge in the early days from 1997 to 2000, due to a complete lack of consensus on many methodological issues. Despite some important references serving as seed documents, especially the so-called 'Code of Practice' (SETAC 1993) and other documents from SETAC, particularly the methodologies of impact assessment and interpretation had to be standardised in parallel to the on-going scientific development.

As such, the establishment of the international standards of LCA (ISO 14040 series) was of utmost importance for the broad acceptance of LCA worldwide. The ISO standards of LCA (ISO 14040 and ISO 14044) in their revised version are, until today, the one and only relevant international standard documents on LCA that are broadly referenced by users and other standardization processes. They represent the constitution of LCA (Finkbeiner, 2014).

### 1.2.3 Environmental Footprinting

According to the Harvard Business Review (Lubin and Esty, 2010), sustainability has become a megatrend for companies over the last decade. Along with a bigger focus on sustainability, LCA and different carbon and environmental footprints have become instrumental components of strategic management practices of business and industry. As such they help decision-makers trying to respond to the enormous challenges of climate change, ecosystem degradation and resource scarcity that are becoming increasingly more visible. LCA-based information is thus now increasingly used around in the world to prepare for example environmental product declarations. The French experiment to display the environmental footprint of products is an example as are the Japanese EcoLeaf or the Korean Carbon Footprint labels, which are similar to the British PAS 2050 or the WRI/WBCSD GHG Protocol Product Life Cycle Accounting and Reporting Standard focus on carbon footprinting.

While many of the before-mentioned labels focus only on one environmental impact category, such as for example climate, the European Commission (2012 a&b) developed a harmonised methodology for the calculation of a so-called Product Environmental Footprint (PEF) and the Organisational Environmental Footprint (OEF). Both, PEF and OEF are part of the Commission's communication on 'Building the Single Market for Green Products' (European Commission 2013a). The methodology has been developed building on the International Reference Life Cycle Data System (ILCD) Handbook developed by the European Commission (2010), as well as other existing methodological standards and

guidance documents (ISO 14040/44, ISO 14025, PAS 2050, WRI/WBCSD GHG Protocol, French experimentation, Sustainability Consortium, etc.). As such it addresses a total of 14 impact categories.

## 1.3 LCA promotion at the international level

### 1.3.1 Overview of the UNEP/SETAC Life Cycle Initiative

In 2002, UNEP, jointly with the SETAC and partners from governments, academia, civil society, business and industry joined forces to promote life cycle approaches worldwide as a way to accelerate a transition towards more sustainable consumption and production patterns. After the publication of the ISO 14040 (see 1.2.1), UNEP and SETAC, aware of the need for dissemination and implementation, jointly began to engage more partners to work on the articulation of science-based existing efforts around life cycle thinking and established the UNEP/SETAC Life Cycle Initiative (Toepfer 2002). The Initiative is governed by the International Life Cycle Board (ILCB), which is composed out of Sponsors, Strategic Partners and Project Chairs. The work of the Initiative is coordinated by a small secretariat which is hosted by UNEP's Division of Technology, Industry and Economics in Paris. More on the history of the Life Cycle Initiative can be found in Sonnemann and Valdivia (2014) and information on its structure, current activities, etc. are available at http://www.lifecycleinitiative.org/.

Building on the achievements from phases 1 and 2 and in particular the results of a stakeholder consultation process in 2011 and 2012, the vision for phase 3 (2012-2017) coined as 'a world where life cycle approaches are mainstreamed' (UNEP/SETAC 2012). Activities in phase 3 focus on creating enabling conditions to (a) enhance the global consensus and relevance of existing and emerging life cycle methodologies and data management; (b) expand capabilities worldwide and make life cycle approaches operational for organizations; and (c) communicate current life cycle knowledge to influence and partner with stakeholders. Five flagship projects are active in the areas of i) data and databases management, ii) global guidance on environmental life cycle impact assessment indicators, iii) hotspots analysis, iv) LCA for organisations and v) global capability development and implementation. Moreover, a special effort on communications has been initiated within the Initiative. An overview of capacity building activities worldwide in the period of 2012-15 and life cycle network development is provided in Figure 1.

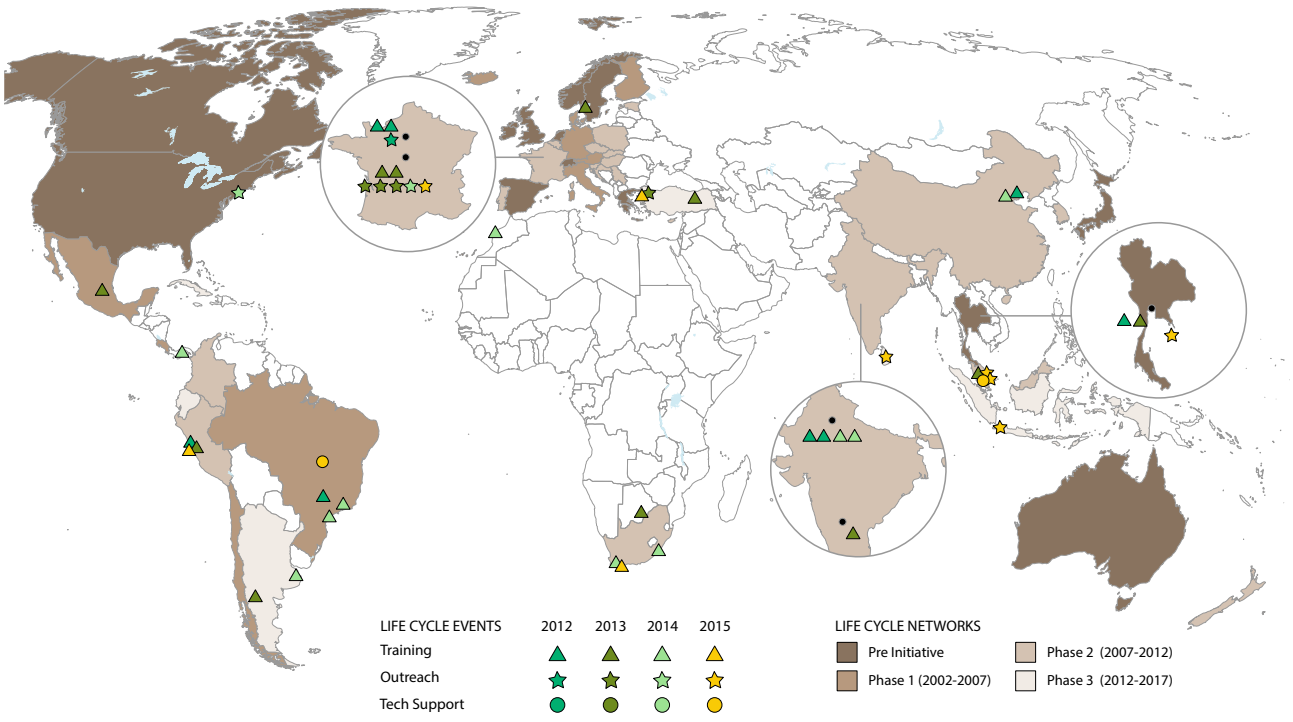



Figure 1: 2012-15 Regional awareness and training activities on LCA databases, footprinting and Life Cycle Management

### 1.3.2 Global Guidance on LCA databases and follow-up capability development activities

A crucial deliverable and on-going activity of the UNEP/SETAC Life Cycle Initiative to help overcome the lack of consistent and high quality LCA data worldwide and to support capacity building for developing countries is the report on Global Guidance Principles for Life Cycle Assessment Databases published in 2011 by UNEP/SETAC (Sonnemann and Vigon, 2011) and the follow-up activities in Phase 3. These principles provide guidance for proper gathering and management of data, which enable better, more reliable LCA results and improve their use for decision-making. Life cycle data availability had been recognized by UNEP as a strategic element for advancing Sustainable Consumption and Production (SCP) through the development and implementation of life cycle based tools and approaches that need these data.

The process behind the publication 'Global Guidance Principles for LCA Databases' (Sonnemann et al 2011, Sonnemann and Vigon 2011) started back in 2007 when the ILCB agreed that the UNEP/SETAC Life Cycle Initiative should produce a manual on developing a country's life cycle inventory data for energy systems as a starting point for a LCA database. However, the manual was never finalized due to the significant amount of diverging comments from LCA experts. Nevertheless, the need for guidance on LCA databases did not disappear as discussions at various forums highlighted the presence of a range of contentious issues concerning the development of LCA databases and datasets. These issues required clarification and in some instances agreement among varying practices before a guidance document could be created. In particular, emerging economies and developing countries need global guidance for their LCA database efforts to guarantee an efficient allocation of resources to ensure reliability and quality, to avoid duplication of efforts, and to ensure comparability and usability between regions (interoperability).

In order to address the methodological issues, it was decided that the best way to proceed was to organize a workshop, bringing together key LCA experts to address the topics of concern, reaching agreements and conclusions to be included in a publication. A Steering Committee equally composed of representatives from governments, business and industry, as well as NGOs and academia, was formed to run the process and lead the organization of the workshop and the publication. Moreover, the Steering Committee with members from developed and developing countries defined the topics to be addressed during the workshop, provided an initial draft structure for the document, and guided the authors in shifting some of the topics between workgroups. A five-day SETAC Pellston Workshop® was held in February 2011 in Shonan Village, Kanagawa Prefecture, Japan. A SETAC Pellston Workshop® brings together around 50 invited experts for an intensive, week-long workshop, where, through the use of working groups and plenary sessions, specific topics are addressed and the discussions and decisions incorporated in the final workshop publication. Pellston Workshops® have a long, successful track record, especially in the area of LCA, and thus this format was deemed ideally suited for the process.

The UNEP/ SETAC publication 'Global Guidance Principles for LCA Databases: A Basis for Green Processes and Products (sometimes named also Shonan Guidance Principles)' edited by Sonnemann and Vigon (2011) is an account of the discussions, agreements reached and future roadmap decided upon during the workshop1. The focus was on the development of guidance for Life Cycle databases, without being sector-specific and not entailing the development of a common database format. The publication did undergo a comprehensive Peer Review Process by SETAC and the UNEP/SETAC Life Cycle Initiative. Some of the key results and recommendations presented in the publication that consists of eight chapters outlined in Figure 2 include:

1 The Global Guidance Principles have been prepared with the input of the leading LCA databases activities both from the public and private sector, including ecoinvent and GaBi, and efforts ongoing in developed world countries like the USA, Australia, Japan, South Korea and Europe; in emerging economies, such as China, Thailand, Brazil, Mexico and South Africa and in industry associations, such as Worldsteel and PlasticsEurope. The Global Guidance Principles are ILCD compatible, with the exception of the section on environmental incidents and accidents, where the ILCD Handbook indicates that if the overall impacts from such small accidents are significant to the LCI results of an LCI dataset, then they need to be singled out and accompany the LCI as part of an optional, separate accident-related inventory.

Current Practice Aspects:

- Data sourcing and data collection are critical elements in producing datasets that are consistent and exchangeable, collection of raw data and the creation of a dataset or datasets from those raw data requires a systematic process and expert know how;
- There is a need to maximize transparency whenever possible, and to provide supplemental information and a review process when the aggregation of data/ datasets cannot be avoided;
- A central position in creating and managing datasets is recommended for data documentation and review elements;
- There is strong support for the view that only complete and verifiable documentation makes a dataset. Detailed guidance is provided for quality meta-data and other dataset documentation elements.

Database Management:

- The Guidance Principles include a clear and meaningful differentiation of what does or does not constitute an "LCI database";
- The primary target audience of the publication is database managers, who manage the data flow and the actors in the data supply chain.

Adaptive Approaches:

- Various adaptive approaches, including Environmentally Extended Input-Output (EEIO), hybrid, time-dynamic and spatially-explicit approaches, were assessed according to their data- related implications, capabilities and constraints to answer questions about their usefulness, limitations and connection to traditional, process-based data;
- Some consideration was also given to social and economic assessments, and associated data/database aspects, as complimentary to environmental LCA;
- The recommendations aspire to expand, and support with identified relevant data, the range of (emerging) questions accessible by LCA using adaptive approaches.

Scenarios – Outlook for the Future:

- Active anticipation of trends in information management are essential to shape users' expectations regarding data, software functionality and interoperability in ways that will alter the scope of what can be done with LCA data in the future.

Following the launch of the publication in 2011, presentations were held and forums were

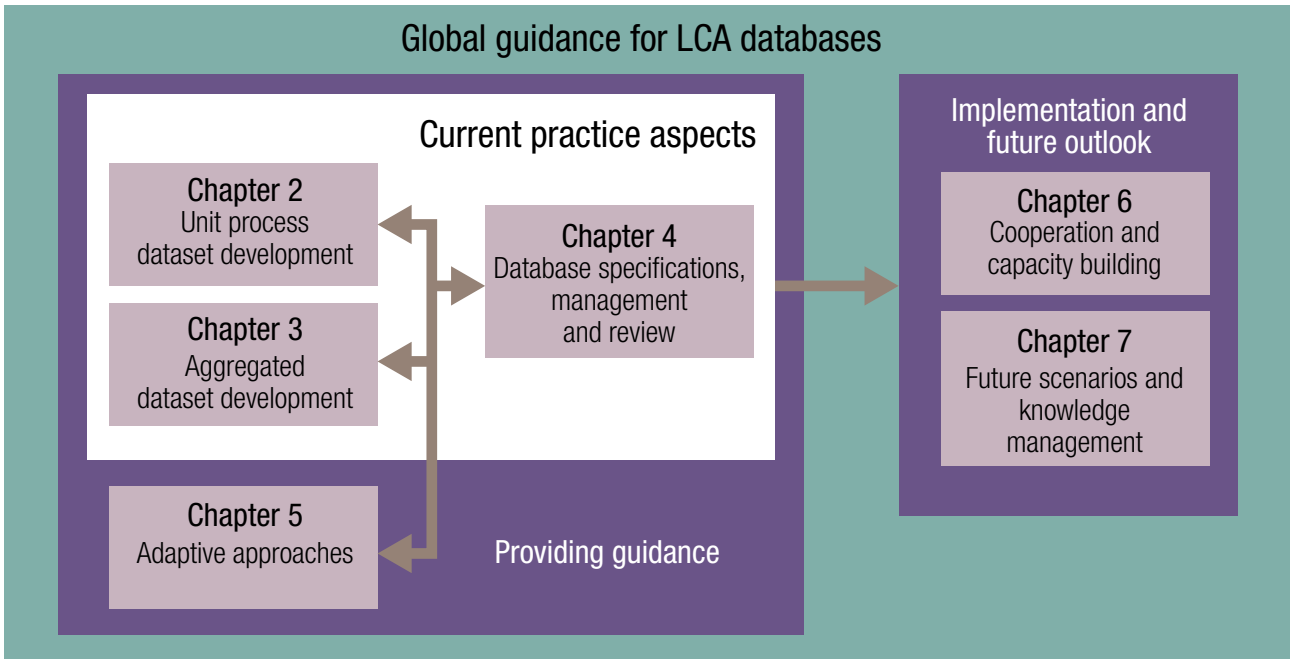



Figure 2: Organizational overview and roadmap of the publication 'Global Guidance Principles for LCA Databases', nicknamed Shonan Guidance Principles (Sonnemann and Vigon 2011)

provided to present and discuss the process, workshop and document. Outreach activities have been organized in particular in emerging economies. Initial events have been run in Chile at the national level and in Tunisia for the Southern Mediterranean region in December 2011. A launch of the Shonan Guidance Principles in Japan for the Asia-Pacific region was organised in January 2012. These activities were followed in June 2012 by two events back to back to the ISO TC 207 Plenary meeting in Thailand, one for the participants of the meeting coming from all around the world and one for the interested Thai audience. As a next step outreach workshops were organized in India (August 2012), Brazil (September 2012) China (November 2012) and Argentina (March 2013) (see a list of 2012/2013 events in Figure 2). These activities were seen as a crucial basis for developing datasets and setting up databases in the rapidly growing and emerging economies of the world. In all these countries there was a huge interest in learning about the Shonan Guidance Principles.

In addition, a special training event on life cycle approaches and environmental footprinting for developing countries was organised in Paris in November 2012, which included a special session on databases. These different events have facilitated the increase of global awareness of the Global Guidance Principles for LCA Databases. The activities were continued in 2013-2015 with training activities for instance in China, India, Brazil, South Africa and Turkey.

These trainings were carried out as part of the UNEP/SETAC Life Cycle Initiative's flagship project 2a on "LCA databases: coordination, networking and capacity building". The training material has been revised so as to ensure that it can be applied in a practical way for training along with concrete application examples. Content will include the topic of how to set up databases and develop datasets, in particular in the developing world. Overall, this flagship project foresees the systematic implementation of the Shonan Guidance Principles to ensure that practice follows the guidance.

Regional and country based life cycle networks are seen as important elements of this implementation strategy. These networks have already demonstrated their value for the organization of awareness-raising events on the Shonan Guidance Principles throughout the past few years. Database managers have also been identified as central actors in the Shonan Guidance Principles. Therefore, establishing multi-stakeholder and multi-region collaboration worldwide among database managers that in general are part of a regional and country based life cycle network is another key element to establish a global roadmap for capability development to generate consistent LCA data and ensure the correct management of related databases.

One key challenge is the lack of consistent and high quality LCA data worldwide. As such, there is a high need for support and capacity building, especially for countries in earlier stages of the development of LCA policies. To address this need UNEP has worked through the UNEP/SETAC Life Cycle Initiative and the European Commission's backed 3-year project on 'Integrating resource efficiency in international supply chains - enabling companies and consumers to benefit from information on life cycle environmental performance of products choices'. The objective of the project is to develop capacities and promote coordination on LCA databases among other life cycle based approaches based on the Global Guidance Principles for LCA Databases.

Future developments in implementing the Global Guidance Principles on LCA Database will also have to consider how to improve the interoperability among Life Cycle Inventory databases in exporting dataset to LCA software products in a consistent and seamless manner. Interoperability is understood as the ability of a system to work with another system. If interoperability is not ensured, significant resources may be required for restructuring the datasets and filling data gaps in order to be able to use the database. It is clear that the interoperability can be improved by taking it into account in the early design phase of database development. The compatibility of the

properties of the new LCA databases developed, in particular in emerging economies, is essential for the interoperability of databases worldwide in the future (Suh, 2013). In this context the work of the International Forum on LCA Cooperation and its Global Network of interoperable LCA Databases is relevant. The network's vision is to establish "a global network comprised of independently-operated and interoperable LCA databases that connects multiple data sources to support life cycle assessment in a way that facilitates sustainability-related decisions" (UNEP, 2016).

# 2. Global mapping of existing life cycle networks at the national level

Chapter 2 gives an overview of the current landscape of existing life cycle networks at the national and regional level. This is done based on the current list of life cycle networks counted by the UNEP/SETAC Life Cycle Initiative, a scientific paper on the topic published by Bjørn et al (2012) and a survey carried out during the summer and autumn 2014 that included also questions related to the current status of mainstreaming life cycle approaches at the national level. Based on these various types of information, common trends and differences among regions and countries with regards to mainstreaming life cycle approaches and national databases are highlighted.

## 2.1 Definition of a life cycle network

Due to the lack of an universally agreed definition of what constitutes a life cycle network, we have decided to base our definition of a life cycle network on the one published by Bjørn et al (2012). According to the definition used within this report, a network is classified as a life cycle network if it meets the following six-criteria. The network:

- Supports life cycle approaches and/or mentions LCA or life cycle thinking in mission and vision statement,
- Includes, as a minimum, members from both the academia and industry or authorities, consultancies, NGOs (here we deviate from the original definition made by Bjørn et al (2012) by allowing also networks without industry partners to be a life cycle network),
- Is a non-profit network and hence uses its revenues to achieve its goals rather than to distribute them as profit or dividends,
- Is based on some degree of central control and coordination,
- Embodies a communication platform to connect all the members (e.g. newsletter, web site, etc.),
- Is stronger if it is an independent entity and not merely a subject-specific subchapter of a larger LCA or SCP network (here we deviate again from Bjørn et al (2012) by not making the fact of having an independent entity part of the network definition but only a strengthening aspect and by extending the larger networks to include SCP).

Taking this definition into account we use the term 'Life cycle network' while Bjørn et al (2012) refers to 'LCA networks'. While both terms can be used interchangeably, we have decided to use the broader term to reflect in our terminology that we also include networks that focus on promoting life cycle thinking and thus are not limited to activities around LCA.

## 2.2 Overview of the current work of the UNEP/ SETAC Life Cycle Initiative on life cycle networks worldwide

The UNEP/SETAC Life Cycle Initiative has developed an overview on life cycle networks worldwide with a list of regional networks and national networks differentiated in various regions of the world: Europe and Central Asia, North America, Asia/ Pacific and Latin America and the Caribbean plus Africa. This is not to be confounded with the UNEP/SETAC Life Cycle Inventory Registry. We would also like to note that not all listed networks fall under the network definition outlined in the previous section, such as for example the LCA Turkey Network Linkedin Group.

### 2.2.1 Regional Life Cycle Networks

Regional networks are independent, but supported by the Life Cycle Initiative. The following networks are mentioned on the Life Cycle Initiative website (UNEP/SETAC, 2014a):

#### Europe and Central Asia

- European Platform on Life Cycle Assessment
- Nordic Life Cycle Association (NorLCA)
- Central and Southeast Europe LCA network (CASE-LCA)

#### Asia/ Pacific

- LCA Agrifood Asia Network
- Latin America and the Caribbean
- Iberoamerican LCA Network

#### Africa

- African Life Cycle Assessment Network (ALCANET)

### 2.2.2 National Life Cycle Networks

With regard to the national networks the following list is provided (UNEP/SETAC, 2014b). Please note that some countries have more than one network. The websites of the regional networks and the national networks that have one are provided in Annex 1.

Europe and Central Asia

- avniR (Life Cycle Assessment Platform) (France)
- Catalan LCA network (Spain)Estonian LCA Network
- FINLCA (Life Cycle Assessment Framework and Tools for Finnish Companies)
- German Network on Life Cycle Inventory Data
- LCA Center Association (Association of Hungarian LCA users)
- LCA Center (Denmark)
- Polish Center for Life Cycle Assessment (PCLCA)
- Rete Italiana LCA (Italian LCA network)
- L'Association SCORE LCA (France)
- Spanish LCA society
- Swiss Discussion Forum on Life Cycle Assessment
- Swedish Life Cycle Center (CPM)
- Linkedin Group: LCA Turkey Network

North America

- The American Center for LCA

Asia/ Pacific

- Carbon Footprint Japan forum
- China Lifecycle Initiative (CNLCI)
- Indian Society for LCA
- India LCA Alliance
- Indonesian Life Cycle Assessment Network (ILCAN)
- Korea Society for Industrial Ecology (KSIE)
- Korean Society of LCA (KSLCA)
- LCA Malaysia
- LCA Society of Japan
- The Institute of LCA, Japan
- Life Cycle Assessment Research Center (LCARC) (South Korea)
- Life Cycle Assessment & Design for Sustainability Network (Sri Lanka)
- Thai LCA network
- Australian LCA Society (ALCAS)
- Life Cycle Association New Zealand (LCANZ)

Latin America

- Argentinian LCA network
- Association for Life Cycle Assessment in Latin America (ALCALA) (Costa Rica)
- Brazilian Association for Life Cycle Assessment (ABCV)
- Colombian LCA network
- Ecuadorian LCA network
- Peruvian LCA network
- Chilean LCA network
- Mexican LCA network

### 2.2.3 Other Networks

In addition, the UNEP/SETAC Life Cycle Initiative lists some other networks that are not the actual focus of this report. Here are some other networks you can contact:

- The Sustainability Consortium
- Global Footprint Network
- International Society for Industrial Ecology (ISIE)
- LCE engineering
- GaBi User Forum
- PRé LCA Discussion List
- LCA links!
- Cluster Research, Excellence in Ecodesign & Recycling (CREER)
- Water Footprint Network
- Water Use in Life Cycle Network
- openLCA user forum
- Umberto Users Forum

Moreover, the multiple life cycle networks are represented on a network maps reproduced in Figure 3. In this way it becomes evident in which regions national life cycle networks are mainly still missing: Africa, Middle East and the post-Soviet states.

An important source of information used by the Life Cycle Initiative is the paper by Bjørn et al (2012) in the International Journal of LCA. Following the tentative life cycle assessment (LCA) network definition reproduced above, a mapping was performed based on a literature search, a web search and an inquiry to stakeholders distributed via the two largest LCA mailing lists. Networks were characterized based on responses from a survey.

An additional restriction that has been applied by

Figure 3: UNEP/SETAC Life Cycle Initiative Networks Map (UNEP/SETAC, 2014c)

Bjørn et al (2012) to the life cycle network definition mentioned above is to prevent the inclusion of inactive networks by excluding identified networks, for which most recent activities visible on their web sites (if they have one) are older than 2008. Partly qualifying networks identified by the mapping activities were included as long as they fulfilled at least four of the six criteria and specifically fulfilled criterion 1 (networks were given the benefit of the doubt if it was not possible to check the fulfilment of a criterion). It was decided to include them in the mapping since the life cycle network definition is merely tentative and since these networks may contribute to a more complete picture of the activities carried out between different stakeholders in relation to the dissemination, application and scientific development of LCA and its related frameworks. Then, Bjørn et al (2012) used the term 'LCA network' interchangeably for fully complying and partly complying networks, unless otherwise stated.

The paper prepared by Bjørn et al (2012) presents 100 identified networks along with some key information. Twenty-nine of the 100 networks fulfilled all six criteria composing the tentative network definition. The networks are mainly located in Europe and the USA, whilst Africa, the Middle East and Central Asia are less covered regions. The survey results (from 25 network responses) indicate that LCA networks appear to be primarily small- to medium-sized (<100 members) and to include a large proportion of academia and industries, including small- and medium sized enterprises, with much less involvement of authorities and non-governmental organisations. Their major activities relate to knowledge sharing and communication, support of case studies, and development of life cycle inventories and impact assessment methods. Globally, an increasing trend in the formation of LCA networks over time is observed, which tends to correlate with the number of LCA scientific publications over the same time period. Continental distributions of networks also show a correlation with the number of LCA publications from the same region.

The results of this first comprehensive international mapping done by Bjørn et al (2012) have served as a basis for deciding that this UNEP publication would be carried out with a strong focus on emerging economies where a lot of efforts are still needed to increase the dissemination and development of LCA worldwide. The UNEP/SETAC Life Cycle Initiative has tried to take up the recommendation of the paper to have a regularly updated list of life cycle networks on their website to facilitate network communication and knowledge sharing.

Method for collecting information on the status of mainstreaming life cycle approaches and characteristics of life cycle networks

In order to update the information collected by Bjørn et al in 2002 discussed above, another more comprehensive survey was conducted in 2014 to identify national life cycle networks and

databases and the general status of life cycle mainstreaming around the world. The survey was mainly distributed through the UNEP/ SETAC Life Cycle Initiative's mailing list which has more than 2500 subscribers.

The questions on the status of mainstreaming were inspired by the pioneering work done by Sagisaka (2004) from AIST, Japan, on the progress on LCA in each Country of the Asia-Pacific Economic Cooperation (APEC) and kept similar to ensure comparability. The questions were the following:

- Are there any training courses and seminars on LCA and other life cycle approaches available in your country?
- Are you aware of universities or research organizations in your country working on life cycle approaches?
- Is there a market for consultancy on life cycle approaches in your country available to assist industries and the government in the implementation of life cycle approaches?
- Are there LCA studies from your country and if so which sector is providing most studies?
- Have life cycle approaches being used in the legislation of your country or region and is so lease specify the policy area where is has been applied?
- What is the level of LCA software penetration in your country?
- What is the level of Life Cycle Impact Assessment (LCIA) implementation in your country?

With regards to the questions on networks, we aligned the questions with the criteria being used by Bjørn et al (2012) to ensure that a similar approach is used:

1. Do you have a life cycle network in your country or region or you plan to develop it?
2. What is the approximate number of members?
3. How would you assess the activity in the network?
4. Has the network the status of a legal entity?
5. Is the membership in the network based on individual or organizational membership?
6. Is there a central control or coordination person or body?

Finally, questions were added on the existence of or plans to develop a LCA database and on the funding needed to promote life cycle approaches at the national level and to work on databases:

- Does your country or region have an LCA database or is planning to develop one?
- What is the level of funding needed to bring the promotion of life cycle approaches in your country to the next level and how much of this would be needed for work on LCA databases?
- Overall funding needed?
- Funding needed for work on databases?

As outlined before, the objective was to focus on the G20 countries, including Spain as a guest country, covering the EU on an average value, plus Switzerland and the following emerging economies: Egypt and Morocco from Africa, Malaysia, Philippines and Thailand from Asia/ Pacific, Chile and Peru from Latin America and the Caribbean.

The target was to get responses from at least 10% of the mailing list members from the G20 countries and the other emerging economies mentioned. A special effort was made to ensure that the target was achieved. The positive response rate was realized for Egypt and Morocco (Africa), from South Korea and Australia (Asia and Pacific) and from Argentina, Brazil, Peru and Mexico (Latin America) as well as from Spain (Europe) with a response rate of over 15%. While unfortunately no response from Saudi Arabia could be registered, very few responses were collected from China, the Philippines, the UK, the Russian Federation and Switzerland. A table with the results with regard to response rate and participation per country and region is provided in Annex 2. A special case is a number of the responses from Australia, Canada and the UK that have the tendency to be overcritical with their own situation in respect to mainstreaming life cycle approaches in comparison to the responses given by the participants of most other countries. Still, the overall response rates indicate that the survey received remarkably good participation in a number of key emerging economies, which reinforces the global scope of this mapping of national networks. The limited responses from especially from China, the Philippines, the Russian Federation and Saudi Arabia however highlight the need to enhance to outreach activities to those countries.

## 2.4 Description of survey results at regional level with regard to the status of mainstreaming life cycle approaches and networks

This section discusses both, the results of the survey with regards to mainstreaming life cycle approaches at regional level as well as the regional networks, databases and funding needs.

### 2.4.1 Europe and Central Asia

#### 2.4.1.1 Mainstreaming

The status of mainstreaming for Europe is based on more than 60 responses, mainly from the former EU-15 member states. That means that the information is not representative for Eastern Europe and Central Asia.

According to the survey results, leading organizations for LCA promotion are mainly academia, consultants and industry. These are also the actors who carry out most of the LCA studies. Survey participants also noted that many good quality training courses and seminars on LCA and other life cycle approaches are offered by academics in Europe. The market for life cycle services is judged by the participants to be developing.

Mainly international LCA software which is produced in Europe is used. However, local software is also being used or developed in some countries in Europe. In most cases LCIA methods with up to 14 impact category indicators, in line with the European Commission's PEF approach (see 1.2.2), have been developed by international (including many European) experts and have been implemented at different levels of maturity. Local LCIA impact category indicators for the whole of Europe, sub-region or countries have also been developed and used.

Unfortunately, the survey does not provide clear information on the use of LCA in legislation in different European countries. The main drivers for the uptake of life cycle approaches appear to be however: Type III labelling/ Environmental Product Declarations, Product Environmental Footprinting, Critical hotspots identification in the supply chain by retailers and big companies, Public procurement regulations, Innovation efforts by companies of any size, Marketing and reputational activities as well as Sustainability Reporting.

#### 2.4.1.2 Networks, Conferences and Databases

The following regional life cycle networks are available in Europe:

- European Platform on Life Cycle Assessment,
- Nordic Life Cycle Association (NorLCA)
- Central and Southeast Europe LCA network (CASE-LCA).

The European Platform on LCA is a European Commission's project coordinated by the Commission's Joint Research Centre (JRC), Institute for Environment and Sustainability (IES) in collaboration with the Environment Directorate General. It has been established to support the development of scientifically robust, consistent and quality-assured life cycle methodology and data in Europe. The European Platform on Life Cycle Assessment is mainly engaged in activities that responds to business and policy needs for social and environmental assessments of supply chains and end-of-life waste management.

The NorLCA was founded in Helsinki in December 2004. It comprises individuals, companies and organizations from Nordic regions working with life cycle approaches and it serves as a mutual platform for industry, authorities, R&D institutions, NGOs and others. It is engaged in activities such as promoting life cycle thinking, life cycle design, life cycle management, life cycle costs, life cycle assessment, product oriented management, sustainable consumption and production, green procurement, green marketing and so on. NorLCA is quite active; its main activity is organizing the annual Nordic multidisciplinary and interactive symposium, in which LCA practitioners in the region gather to discuss, listen, learn and be inspired by each other.

CASE-LCA is an life cycle network of research institutes and LCA centres from Central and Southeast Europe. Its members are from individual, companies and organizations that are using or would like to practice life cycle approaches.

CASE-LCA's main activities are organizing annual multidisciplinary, and interactive symposia, where professionals within the field meet for discussion. It also organizes the annual symposium that addresses designers, product developers, architects, economists, LCA-specialists and others with an interest in life cycle thinking.

With regards to conferences in Europe and Central Asia, SETAC Europe with its LCA Advisory Group has been the starting point for the life cycle community with an important annual meeting in particular for the LCA methodology developers and the LCA Case Study Symposium for the practitioners. The latter has played an important role in the past 20 years for building capacity in Eastern Europe by having a number of events in this part of Europe like in Poznan, Poland, in 2010, Budapest, Hungary, in 2011 and Novi Sad, Serbia, in 2014. In addition, since 2001, nearly every second year a Life Cycle Management (LCM) Conference has been organised under the umbrella of the so-called LCM Committee with a strong participation of industry and business. The last LCM conference took place in August/September 2015 in Bordeaux, France, which again brought together a balanced mix of academics and industry representatives. Moreover, the originally France-focussed annual [avniR] conference series on LCA in practice has become more and more a European event.

With regards to databases at the regional level the survey participants pointed to the European Life Cycle Database (ELCD). The respondents agreed that there is a still a need for more funding to promote life cycle approaches and for work on database in the region.

## 2.4.2 North America

### 2.4.2.1 Mainstreaming

Twenty answers were registered from respondents from North America, with roughly two-thirds from the United States and one-third from Canada. According to the survey results different stakeholders, such as academia, consultants, governmental agencies, NGO and industries, lead the promotion of LCA in North America. There appear to be many good quality training courses and seminars on LCA and other life cycle approaches offered in North America. The market for life cycle services is also considered to be fully developed and LCA studies are mainly carried out by academics, consultants and big companies.

International software and local software is being used or developed in North America. In most cases LCIA methods with up to 14 impact category indicators have been developed by international experts and have been implemented in the region. Local LCIA impact category indicators have also been developed and used for example for the region of Quebec.

There is no clear information coming out from the survey on the use of LCA in legislation. The main drivers for the uptake of life cycle approaches appear to be: Type III labelling/ Environmental Product Declarations, Critical hotspots identification in the supply chain by retailers and big companies, Public procurement regulations, Innovation efforts by companies of any size, Marketing and reputational activities, Sustainability Reporting, Public voluntary commitments. As such there appear to be quite some similarities to the situation in Europe.

### 2.4.2.2 Networks, Conferences and Databases

Due to the fact that the American Centre for Life Cycle Assessment (ACLCA) is mainly active in the United States, there is no clear consensus within the survey respondents on the availability of a regional network in North America. However, with regard to the most visible conference series in the region, it is clearly the annual LCA conferences organised by ACLCA. LCA XV was organised with lot of success in October 2015 in Vancouver, Canada. In respect to the databases the same situation holds true as for a regional network since the databases established in the USA are limited in scope to the national level, while other efforts for instance by CIRAIG as well as Athena and Quantis collect Canadian-specific data. In general, there is agreement among the survey participants that funding is required to bring the LCA work to the next level. To this end especially a need to work on a database at the regional level has been identified.

## 2.4.3 Asia/ Pacific

### 2.4.3.1 Mainstreaming

More than 40 respondents from Asia/Pacific did provide answers on the status of mainstreaming life cycle approaches in this rapidly industrialising

region. The main organizations for promoting LCA are academia, consultants and government. Mainly academics and big companies in Asia/ Pacific offer multiple training courses and seminars on LCA and other life cycle approaches. The market for life cycle services appears to be in its developing stages. Academics and big companies do most of the LCA studies.

Mainly international LCA software is used in the Asia/ Pacific region but in some countries local software solutions have been developed. LCIA methods with up to 14 impact category indicators are most widely implemented, while local LCIA impact category indicators have also been developed. In a number of countries there is also a limited use of the variety of impact category indicators but rather a focus on Global Warming Potential for carbon footprinting.

The survey respondents overall agree that life cycle assessment has not yet been used in the legislation in the Asia/Pacific region. Type III labelling/ Environmental Product Declarations, Product Environmental Footprinting, Critical hotspots identification in the supply chain by retailers and big companies and Sustainability Reporting are the main drivers for the uptake of life cycle approaches in the region.

#### 2.4.3.2 Networks, Conferences and Databases

Different regional life cycle networks are available in the Asia/Pacific region:

- LCA Agri-Food Asia network,
- South and South-East Asia (SEASIA) Network on Life Cycle Initiative of UNEP and
- ASEAN+ Network on LCA and Carbon Footprint.

The LCA Agri-Food Asia network is composed of members from governmental organizations, higher research and educational institutes and private companies. It aims at expanding the applications of LCA in the agri-food sector at the regional level, collaboration in R&D on LCA in the agri-food sector at regional level and developing an Asian Food database. One of the first activities was the organisation of the first regional workshop on "LCA Agri-food Asia" in February 2012. The workshop was organised by Kasetsart University, the Joint Graduate School of Energy and Environment, the Asian Institute of Technology and NSTDA of Thailand along with the National Agriculture and Food Organisation (Agriculture Research Centre) and TCO2 Company of Japan. About 160 participants from 10 different countries attended the event. Experiences on LCA in agri-food were shared from Indonesia, Japan, Korea, Malaysia and Thailand. (Gheewala, 2012). There were two additional events so far, in Indonesia (2013) and then Thailand (2014 & 2015) and Malaysia (2015). The network tries to rotate the venue to have more participation from different countries. The next target is Vietnam, though the critical mass is yet to be developed there.

The South and South-East Asia (SEASIA) Network on Life Cycle Initiative of UNEP is supposed to include members from all developing countries in South, South-East and East Asia regions, but only the country page for India is active.

The following projects were proposed for the ASEAN+ Network on LCA and Carbon Footprint: National Life Cycle Inventory Databases, LCA of Food/ Agriculture, LCA of Biomass/ Bio-fuels. Carbon Footprint/ Water Footprint and Ecodesign (Inaba and Mungchaoren, 2010). However, no network website was found.

With regard to LCA conferences in Asia/ Pacific, in addition to the events mentioned of the LCA Agri-food Asia network, the Ecobalance conference is the oldest and most visible meeting point in the region which brings together LCA practioners every two years in Japan with lot of participants from different countries in Asia and the Pacific. Held biennially since 1994 and organised by the Institute of Life Cycle Assessment, Japan, EcoBalance is one of the longest established international conferences discussing methodologies and practices for sustainability based on life-cycle thinking. Moreover, the Australian Life Cycle Assessment Society (ACLCA) and the Life Cycle Association of New Zealand (LCANZ) take turns in organising the annual regional life cycle conference in the Pacific region.

Work on regional databases is on-going as part of the Japanese efforts supported by METI, JETRO and AIST with regard to LCA databases and as part of the LCA Agri-Food Asia network. According to the survey respondents, overall funding is needed to bring the promotion of life cycle approaches in

Asia/Pacific to the next level and to speed up the development of regional databases.

### 2.4.4 Latin America and the Caribbean

#### 2.4.4.1 Mainstreaming

More than 40 survey participants from Latin America and fewer from the Caribbean indicate that the leading organizations for LCA promotion are academia and consultants. Multiple training courses and seminars on LCA and other life cycle approaches are offered mainly by academics in Latin America who also carry out most of the LCA studies. The market for life cycle services is described as developing.

In Latin America international LCA software is bought by academics for their LCA studies as well as by a number of industries. In most cases LCIA methods with up to 14 impact category indicators, which have been developed by international experts, have been applied. Some academics have also started to develop and use local LCIA impact category indicators. According to the results of the survey there also seems to be a habit of using only a limited number of impact category indicators, such as Global Warming Potential for Carbon Footprinting.

LCA has been introduced for example in Mexico as a tool in five laws and other countries have also taken it up as part of there sustainable purchasing regulations, such as Brazil and Costa Rica. The main drivers for the uptake of life cycle approaches are: Type III labelling/ Environmental Product Declarations, Product Environmental Footprinting, Critical hotspots identification in the supply chain by retailers and big companies and Sustainability Reporting.

#### 2.4.4.2 Networks, Conferences and Databases

The Iberoamerican LCA network which is supported by the UNEP / SETAC Life Cycle Initiative has members from diverse organizations such as universities, research institutes, standard organizations, companies, professional associations, government agencies, individual professionals and students from Latin America. The network has executive committee members from Argentina, Brazil, Chile, Colombia, Costa Rica, Cuba, Mexico, Peru, Spain and Portugal.

The network is also engaged in different activities such as providing a virtual site for the exchange of documentation, dissemination of events, courses, thesis and other topics related to LCA, promotion of life cycle thinking and the use of tools based on a life cycle approach (eco-labelling, ecodesign, LCM, water footprint, carbon footprint, S-LCA, E-LCA, etc.) and foster greater cooperation between universities, national and international institutions for the widespread use of LCA based approaches and tools.

Every second year, the Conferencia Internacional de Análisis de Ciclo de Vida en Latinoamérica (CILCA) provides a venue for the sharing of ideas and experiences related to the application and promotion of life cycle assessment and related tools in Latin America and the Iberian Peninsula. Previous conferences were organised in San José, Costa Rica (2005), Sao Paulo, Brazil (2007), Pucón, Chile (2009), Coatzacoalcos, Mexico (2011) and Mendoza, Argentina (2013) and in Lima, Peru (2015). The next conference is going to be organized in Medellín, Colombia. This event is of great importance for the economic development of the region, considering that life cycle assessment supports the improvement of the decision-making process towards sustainability in organizations.

First discussions around the development of a regional LCA database have recently begun during a workshop in Peru. Discussions built on the positive developments that have taken place over the past few years in Latin America where a few Life Cycle Inventory (LCI) databases have been launched at the national level (e.g. Mexico and Brazil and more recently Chile). Also in this region funding is required to bring the LCA work to the next level; there is a need for overall funding and for work on databases in the region.

### 2.4.5 Africa

#### 2.4.5.1 Mainstreaming

Africa is the region with the lowest number of survey participants of a bit more than ten (10) responses. From previous research it has already become clear that this region has currently the lowest level of mainstreaming of life cycle approaches. Hence, it is not surprising that the market for life cycle services is not developing but very limited.

The leading actors for LCA promotion are academia

and consultants. With regard to the offered education there are huge differences across the continent. In some of the East African Community (EAC) countries, such as for example in Rwanda, Kenya, Tanzania and Uganda, trainings have been offered through the "Trade Promotion through Standardisation in the EAC Region", a joint programme between the East African Community (EAC) and Swedish Standards Institute (SIS) funded by the Swedish International Development Cooperation Agency (Sida). In addition, in South Africa where LCA has been promoted for long time, mainly academics and big companies offer multiple training courses and seminars on LCA and other life cycle approaches, whereas in other countries such as Morocco and Nigeria only LCA on carbon footprinting is offered. According to the survey results, research on LCA and related topics is limited to activities in large industries; LCA studies are mainly undertaken by academics. With regard to LCA software penetration, international LCA software is used and LCIA is often restricted to the use of the Global Warming Potential for carbon footprinting.

The survey respondents not life cycle approaches have not yet been used in the legislation in Africa. Critical hotspots identification in the supply chain by retailers and big companies, marketing and reputational activities, Sustainability Reporting, Product Environmental Footprinting and academics wishing to promote the concept appear to be the main drivers for the uptake of life cycle approaches in Africa according to the survey.

#### 2.4.5.2 Networks, Conferences and Databases

The regional network is the African LCA Network (ALCANET). The network basically aims to support the research process, provide teaching and training activities and foster the public understanding of LCA in the region. However, it is not very active and engaged in few activities such as an email group, occasional workshops, sharing of information on LCA events etc. The news page of the network's communication platform has for example not been updated since 2005.

In Africa there is no life cycle focused conference series. However, the African Roundtable on Sustainable Consumption and Production (ARSCP), as a regional coordinating institution and registered as a not-for-profit NGO, organises sessions on topics related to life cycle thinking as part of its regular meetings, similar to SETAC Africa.

No regional LCA database is available but according to the survey participants there is a plan to develop one. It is also clear that there are huge funding needs which need to be met in particular by the international donor community to strengthen the LCA activities on this continent.

## 2.5 Description of survey results with regard to the status of mainstreaming life cycle approaches at national level

In addition to the regional situation as described in the previous section, the survey also provides information on the national situation in the report's target countries. The actual survey results with regards to the status of mainstreaming life cycle approaches at national level are available in the country fact sheets in Annex 3. In order to cover the national level, we have decided to represent the results of the survey in two different forms: An overview matrix of some of the key answers which provides an easy overview as well as specific world maps for the most relevant aspects covered. To identify progress over the last decade, we compare the answers received for several questions with the survey results obtained by Sagisaka (2004). We include an analysis of the trends and differences in the status of mainstreaming between countries and their related regions and take selected national examples to provide more background information.

## 2.5.1 Assessment matrix

Table 1 and Table 2 depict the results to a number of key questions that were asked as part of our survey. The answer options are color coded and thus provide an instant overview of the status in each country listed. Please note that EU average data is depicted in the last row of each of the two tables provided.

## 2.5.2 Level of education

The first world map developed based on our survey in Figure 4 shows the level of education activities in the various countries as answer to the question: Are you aware of training courses and seminars on LCA and other life cycle approaches available in your country? As we can see from a comparison with Figure 5 on LCA seminars and training in APEC countries in 2004 the situation

| Assessment Matrix - Status of Mainstreaming | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Education | | | Research | | | Market for Consultancy Services | | | LCA Studies | | | LCIA methods | | |
| | Are there any training courses and seminars on LCA and other life cycle approaches available in your country? | | | Are you aware of universities or research organizations in your country working on life cycle approaches? | | | Is there a market for consultancy on life cycle approaches in your country available to assist industries and the government in the implementation of life cycle approaches? | | | Are there LCA studies from your country and if so which sector is providing most studies? | | | What is the level of Life Cycle Impact Assessment implementation in your country? | | |
| | Many of good quality | Multiple on various topics | Few | Many | Several | Few | Fully developed | Developing/ limited | None | Many, including big companies | Some, mainly by academics or consultants | Very few | A local LCIA indicator has been developed | Use of international set of LCIA indicators | Limited use of LCIA indicators, focus on CFP |
| Target countries | | | | | | | | | | | | | | | |
| Chile | | | | | | | | | | | | | | | |
| Peru | | | | | | | | | | | | | | | |
| Malaysia | | | | | | | | | | | | | | | |
| Thailand | | | | | | | | | | | | | | | |
| Philippines | | | | | | | | | | | | | | | |
| Egypt | | | | | | | | | | | | | | | |
| Morocco | | | | | | | | | | | | | | | |
| India | | | | | | | | | | | | | | | |
| Russian Federation | | | | | | | | | | | | | | | |
| South Africa | | | | | | | | | | | | | | | |
| Turkey | | | | | | | | | | | | | | | |
| Brazil | | | | | | | | | | | | | | | |
| Mexico | | | | | | | | | | | | | | | |
| China | | | | | | | | | | | | | | | |
| Indonesia | | | | | | | | | | | | | | | |
| Australia | | | | | | | | | | | | | | | |
| Canada | | | | | | | | | | | | | | | |
| United States | | | | | | | | | | | | | | | |
| United Kingdom | | | | | | | | | | | | | | | |
| France | | | | | | | | | | | | | | | |
| Germany | | | | | | | | | | | | | | | |
| Italy | | | | | | | | | | | | | | | |
| Spain | | | | | | | | | | | | | | | |
| Argentina | | | | | | | | | | | | | | | |
| Saudi Arabia | | | | | | | | | | | | | | | |
| Japan | | | | | | | | | | | | | | | |
| South Korea | | | | | | | | | | | | | | | |
| Switzerland | | | | | | | | | | | | | | | |
| EU-28 average | | | | | | | | | | | | | | | |

Table 1: Assessment matrix results for mainstreaming

| | Assessment Matrix - Network Characterization | | | | | | | | | Software and Database | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Network Availability | | | Activity | | | Legal Entity | | | LCA software | | Database | | |
| | Do you have a life cycle network in your country or region or you plan to develop it? | | | How would you assess the activity in the network? | | | Has the network the status of a legal entity? | | | What is the level of LCA software penetration in your country | | Does your country or region have an LCA database or is planning to develop one? | | |
| | Network | Unclear situation | No network | Network is very active | Some activity in network | Only little or no activity | Legal entity | Inconsistent responses | No legal entity | LCA software used | Not available | Database | Plan to develop | No database |
| Target countries | | | | | | | | | | | | | | |
| Chile | | | | | | | | | | | | | | |
| Peru | | | | | | | | | | | | | | |
| Malaysia | | | | | | | | | | | | | | |
| Thailand | | | | | | | | | | | | | | |
| Philippines | | | | | | | | | | | | | | |
| Egypt | | | | | | | | | | | | | | |
| Morocco | | | | | | | | | | | | | | |
| India | | | | | | | | | | | | | | |
| Russian Federation | | | | | | | | | | | | | | |
| South Africa | | | | | | | | | | | | | | |
| Turkey | | | | | | | | | | | | | | |
| Brazil | | | | | | | | | | | | | | |
| Mexico | | | | | | | | | | | | | | |
| China | | | | | | | | | | | | | | |
| Indonesia | | | | | | | | | | | | | | |
| Australia | | | | | | | | | | | | | | |
| Canada | | | | | | | | | | | | | | |
| United States | | | | | | | | | | | | | | |
| United Kingdom | | | | | | | | | | | | | | |
| France | | | | | | | | | | | | | | |
| Germany | | | | | | | | | | | | | | |
| Italy | | | | | | | | | | | | | | |
| Spain | | | | | | | | | | | | | | |
| Argentina | | | | | | | | | | | | | | |
| Saudi Arabia | | | | | | | | | | | | | | |
| Japan | | | | | | | | | | | | | | |
| South Korea | | | | | | | | | | | | | | |
| Switzerland | | | | | | | | | | | | | | |
| EU-28 average | | | | | | | | | | | | | | |

Table 2: Assessment matrix results for network characterisation as well as software and databases

has improved in the last 10 years. Now we can state that most emerging economies have multiple training courses, with the exception of Indonesia, Russia, the Philippines and Saudi Arabia. According to the survey results, many good quality courses are available in the United States, China, Japan, South Korea, Germany and France.

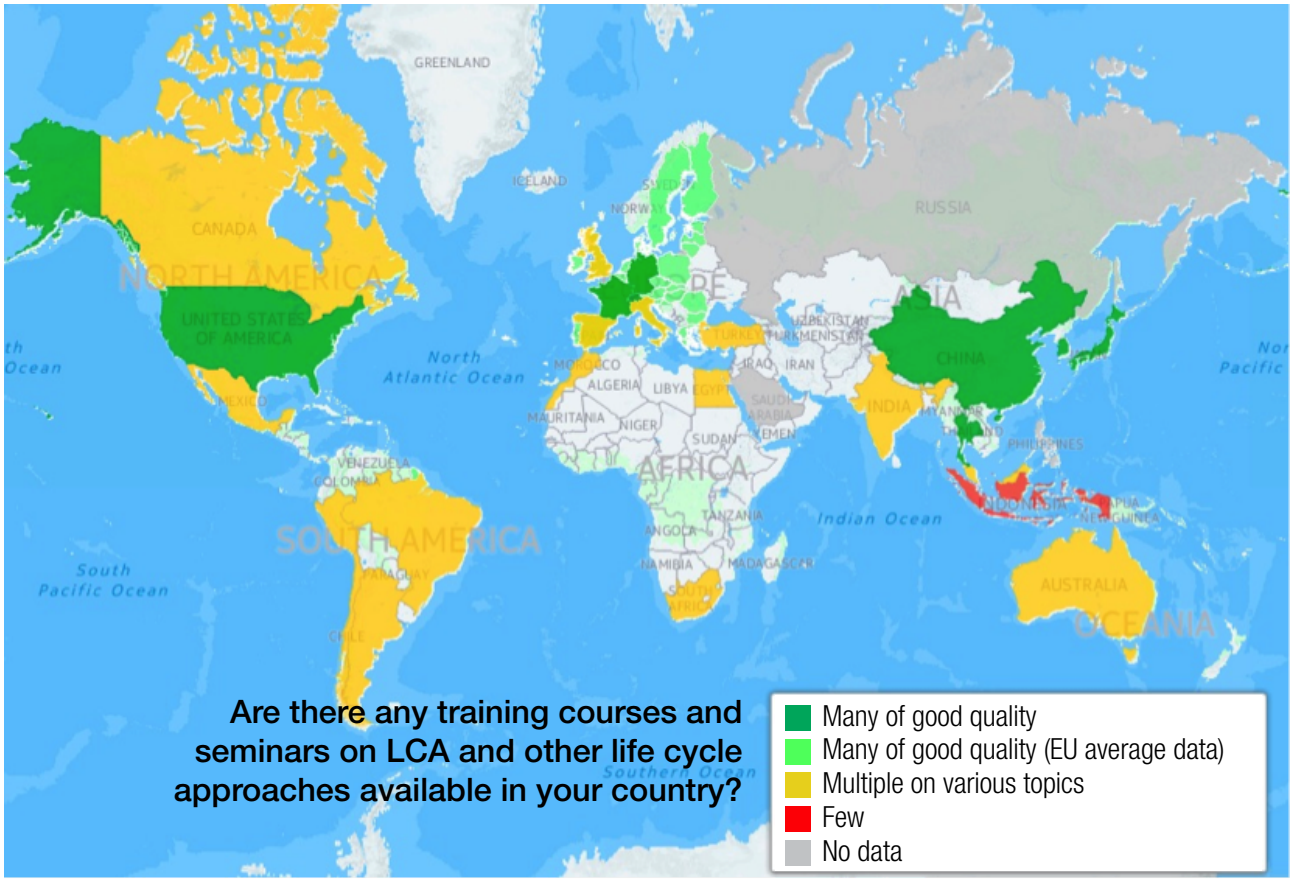



Figure 4: Level of education activities in the countries around the world covered by the survey

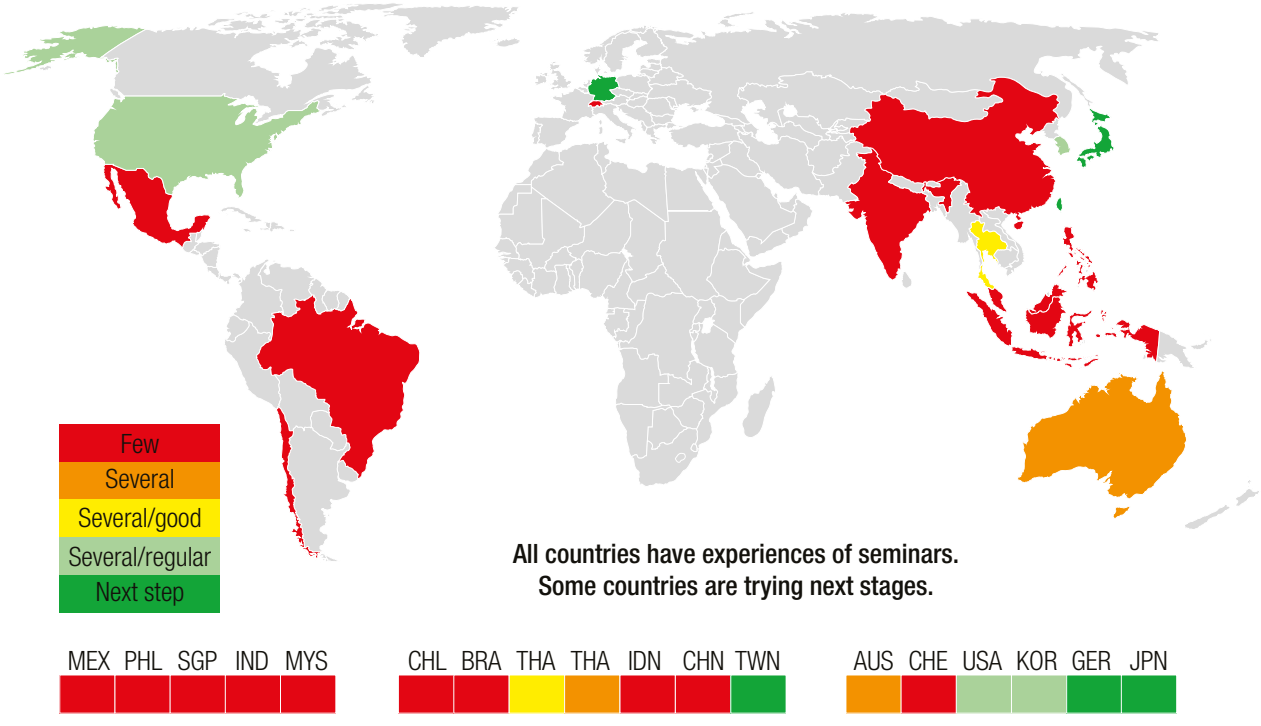



Figure 5: Level of LCA seminars and training in APEC countries in 2004 (Sagisaka, 2004)

### 2.5.3 Market for consultancy services

The second world map in Figure 6 provides an overview of the maturity of the market for consultancy services in the countries around the world covered by the survey. The related question is: Is there a market for consultancy on life cycle approaches in your country available to assist industries and the government in the implementation of life cycle approaches? Most

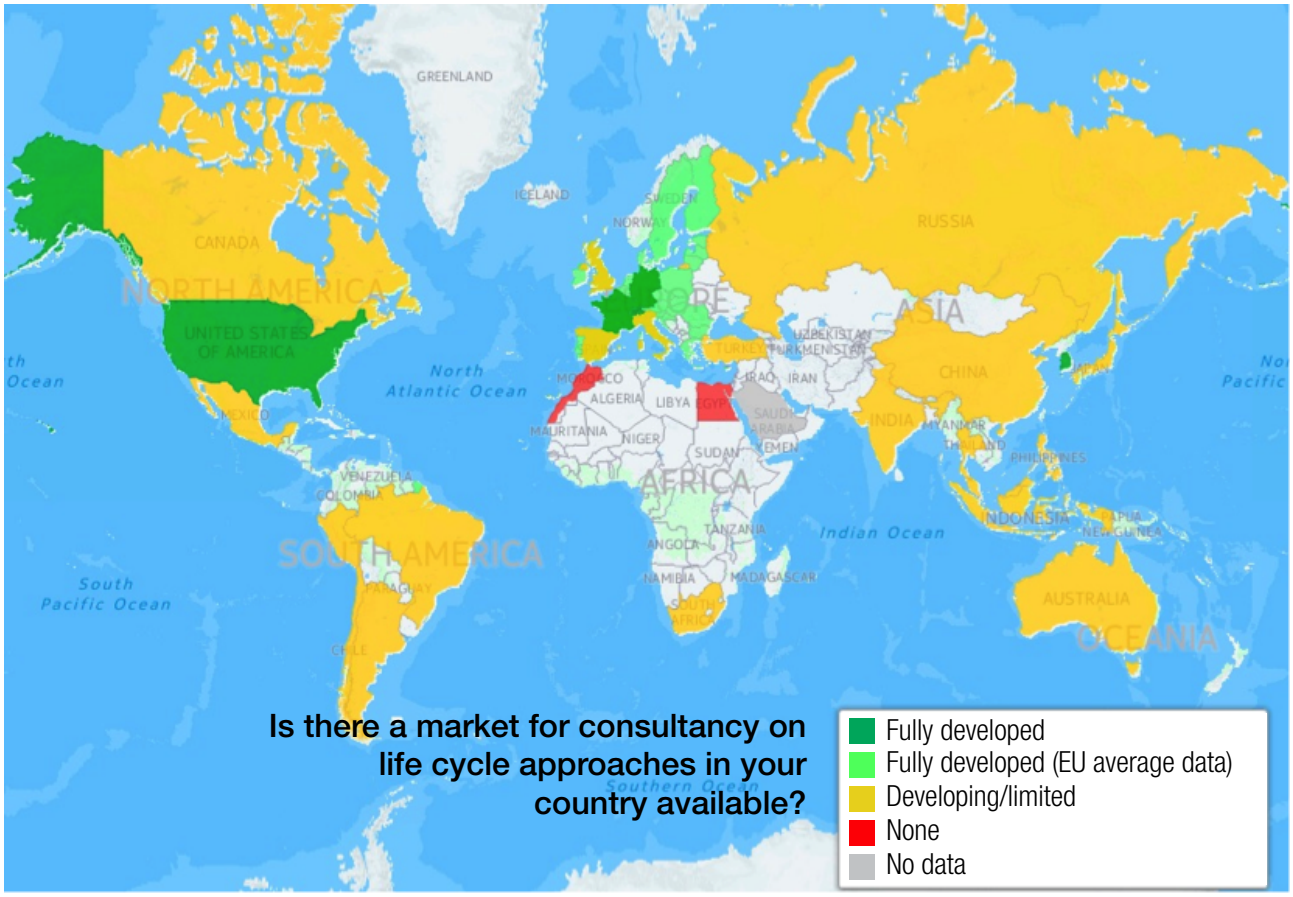



Figure 6: Maturity of the market for consultancy services around the world in line with survey

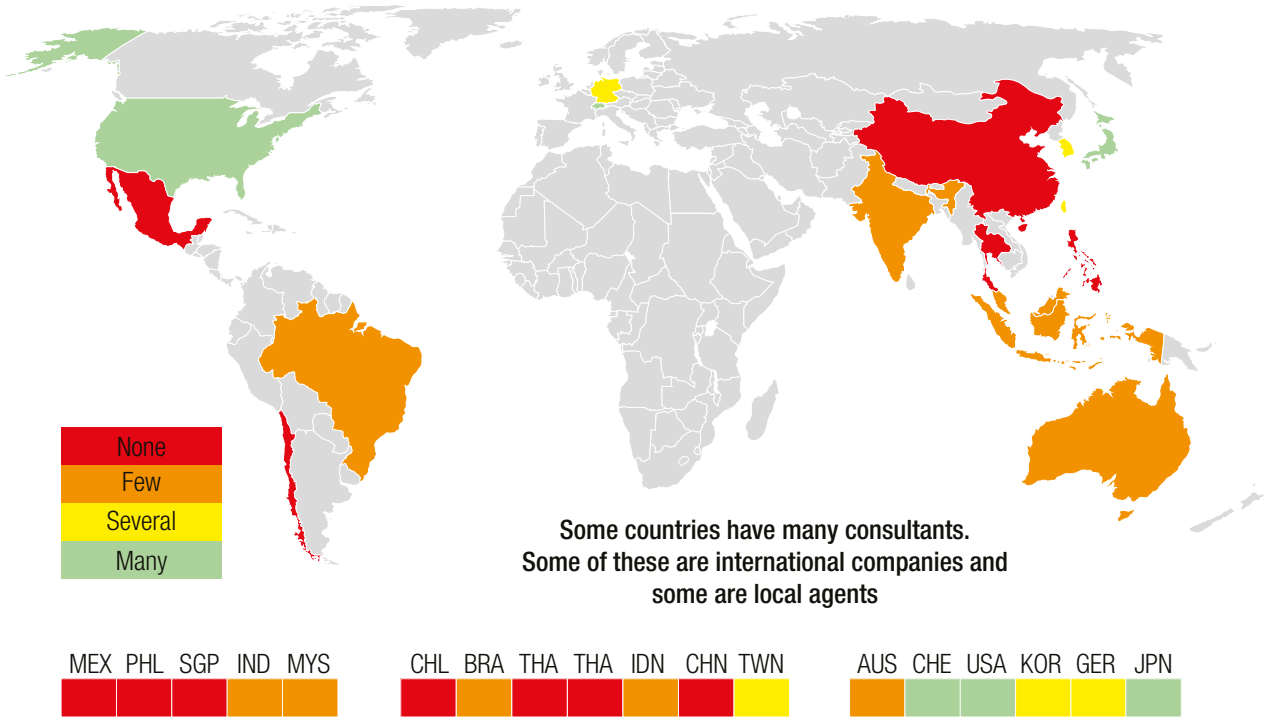



Figure 7: Level of LCA consultants in APEC countries in 2004 (Sagisaka, 2004)

respondents believe that the market in their country is developing or limited. Only in Egypt, Morocco and Saudi Arabia survey respondents did not believe that there was a potential for a consultancy market. Here the situation has improved tremendously in the last ten years if these results are compared with those from Sagisaka (2004) in Figure 7.

### 2.5.4 Research activities

The third world map in Figure 8 presents the level of research activities answering the question: Are you aware of universities or research organizations in your country working on life cycle approaches? We see that there are important differences in the level of research activities in the countries and related regions as also indicated by Bjørn et al (2012) with regard to the correlation of networks and scientific publications. According to the survey results Argentina, Brazil and especially Thailand are the exceptions among the emerging economies with regards to having several to many universities or research organizations doing research in the area of LCA.

### 2.5.5 Case studies

The fourth world map in Figure 9 (next page) addresses the level of preparation of case studies around the world in line with the answers to the survey question: Are there LCA studies from your country and if so which sector is providing most studies? We observe that most emerging economies have LCA studies, mainly published by academics as those of companies are usually not accessible to the public. Unfortunately, only a few or no studies are reported for Chile, Egypt, India, Indonesia, Morocco, Russia. and Saudi Arabia. While Thailand is the single rapidly growing economy for which the respondents indicate many LCA studies, including from big companies, many LCA studies are available in most of the developed countries including Canada, United States, Japan, South Korea, France, Germany, Italy, the UK and Switzerland.

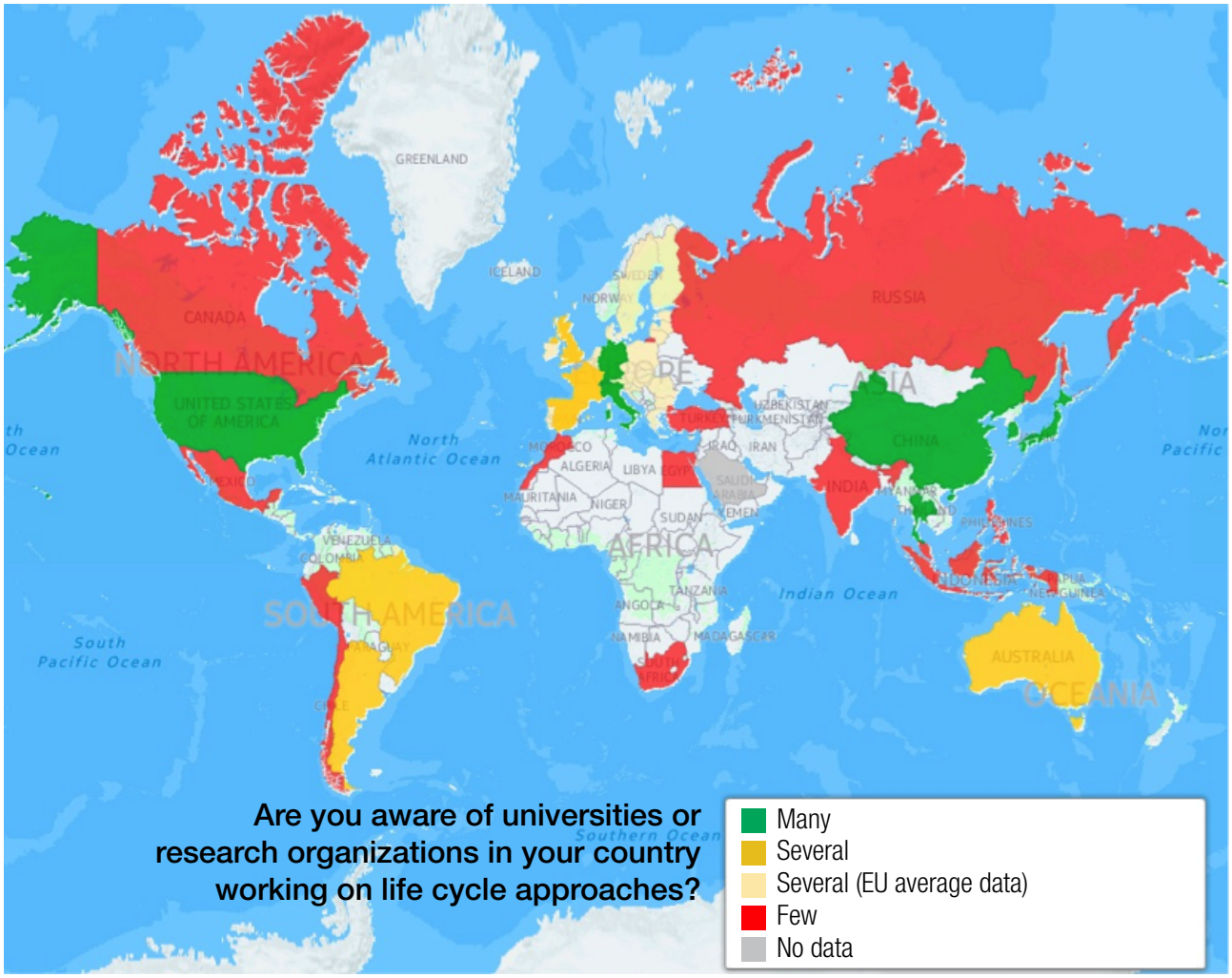



Figure 8: Level of research activities in the countries around the world covered by the survey

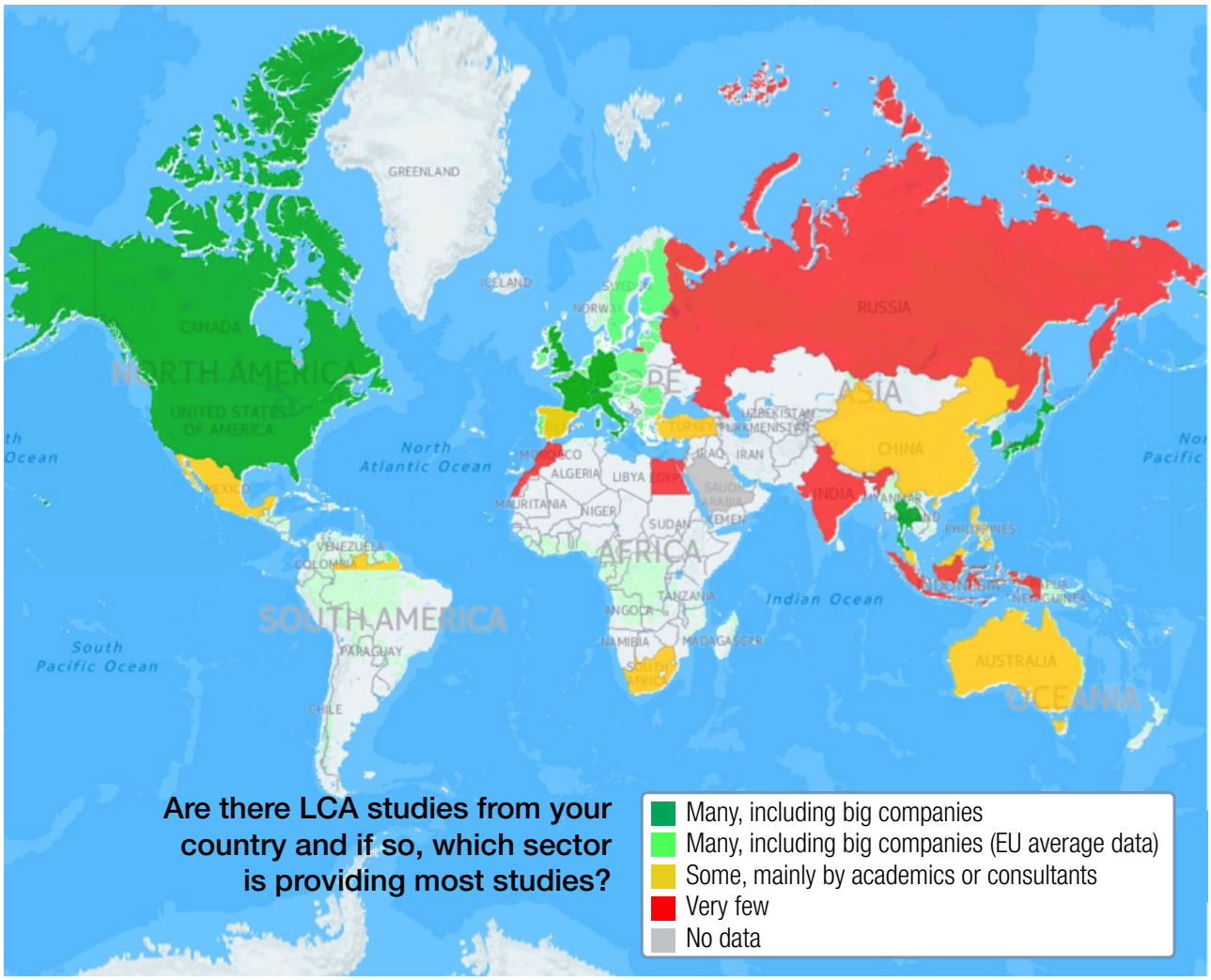



Figure 9: Level of the preparation of LCA studies around the world in line with the survey

### 2.5.6 LCIA implementation

The fifth world map in Figure 10 shows the way of using Life Cycle Impact Assessment in the countries around the world covered by the survey. This corresponds to the question: What is the level of Life Cycle Impact Assessment (LCIA) implementation in your country? The results represented in the world map are based on the sometimes difficult to interpret responses received and expert judgement by the authors with the support of scientific publications. The answer that a local LCIA indicator has been developed means in practice that in most countries covered by the survey research there has at least been a start on using Life Cycle Impact Assessment. However, that does not mean that the development of an own national operational LCIA method, like LIME in Japan, or the adaptation of one or more international indicator(s) by developing regional characterization factors, as done for instance within the context of IMPACT World+ has taken place. In most countries, the practitioners continue to use an international set of LCIA indicators. From the comparison with the results of the survey done by Sagisaka (2004) reproduced in Figure 11, we can conclude that the level of knowledge with regard to Life Cycle Impact Assessment methods has increased in rapidly growing and emerging economies for 10 years. The survey results for Indonesia, Philippines, Morocco, Turkey, Russia and Saudi Arabia provide indications that these countries have a limited use of LCIA methods and, if they do footprinting, focus only on the GHG emissions. Moreover, relevant emerging economies like Chile, Peru, India, and Malaysia seem not to have started with the development of local LCIA indicators or characterisation factors for regional conditions. Positive developments are however taking place in Mexico and South Africa which have started their work with a focus on water impact modelling.

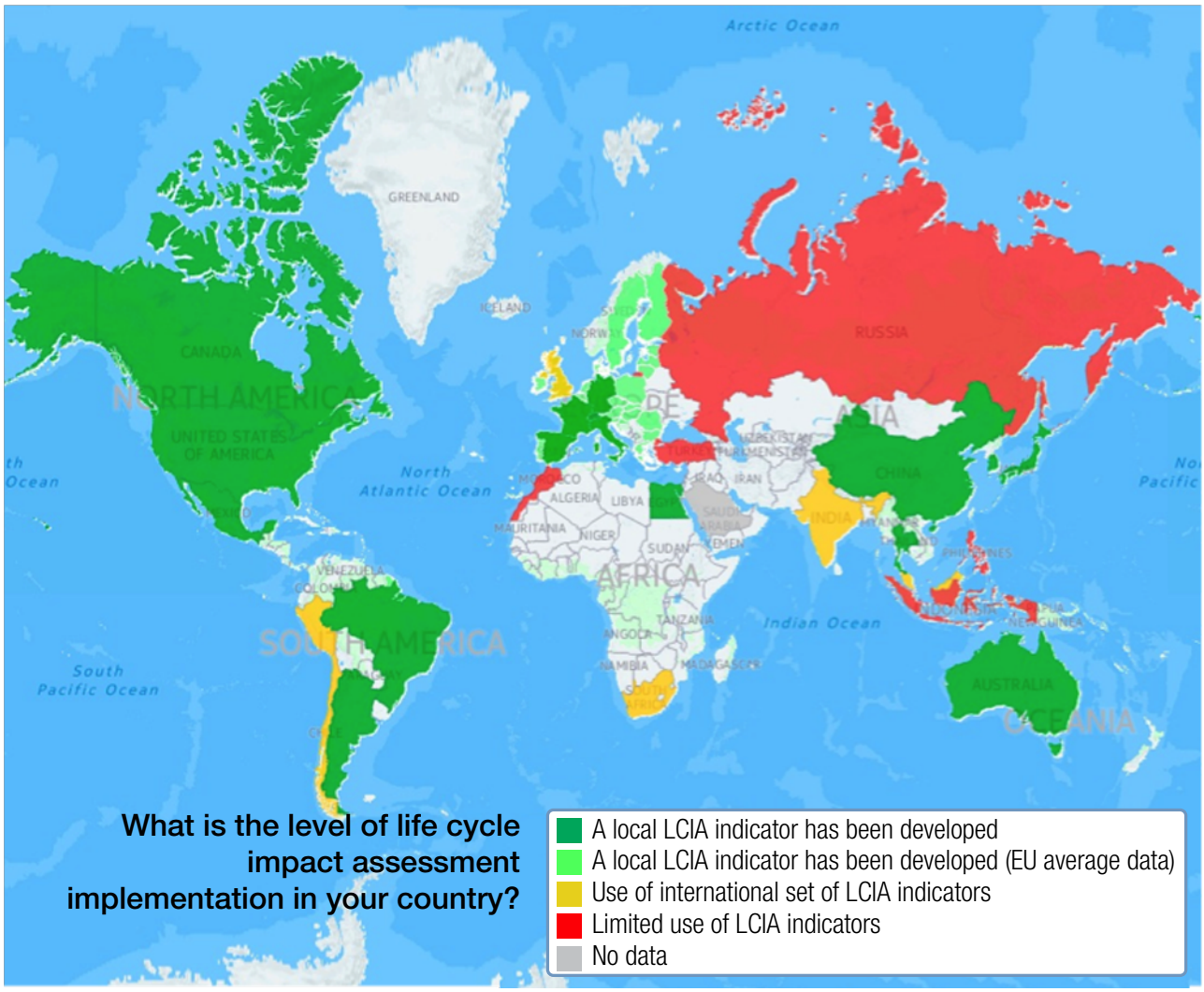



Figure 10: Level of LCIA activities in the countries around the world covered by the survey

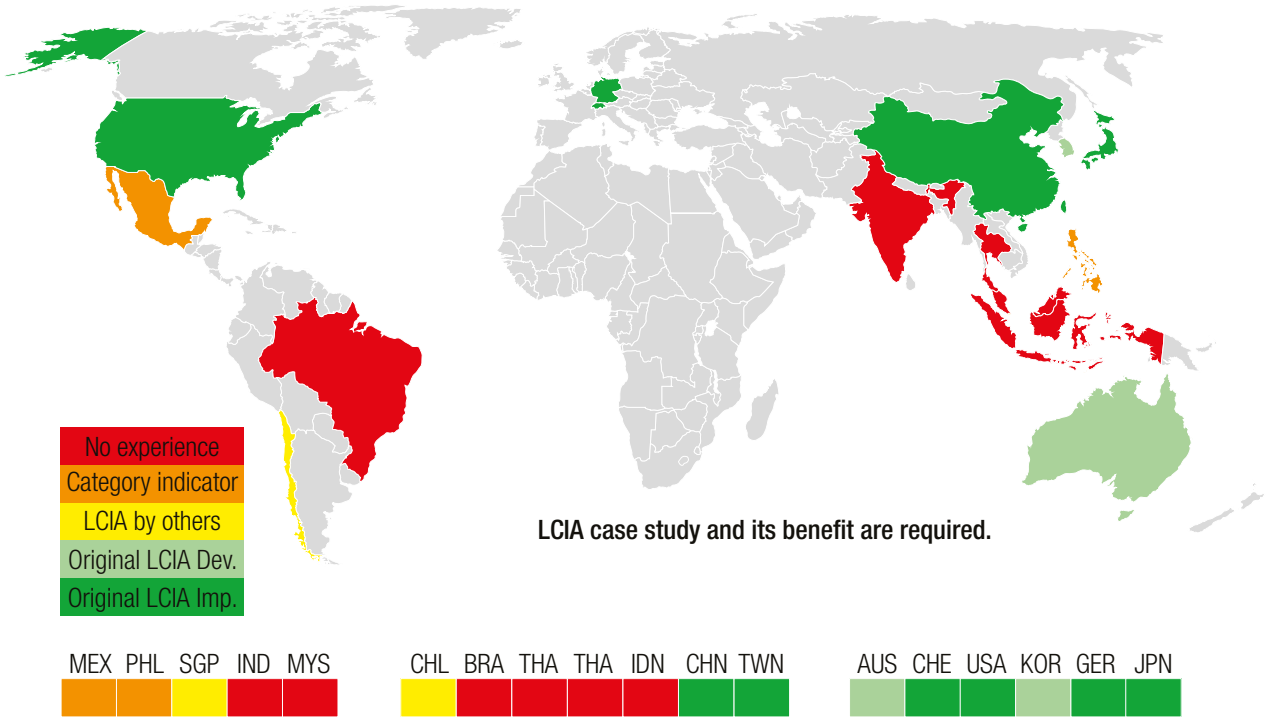



Figure 11: Level of LCIA implementation in APEC countries in 2004 (Sagisaka, 2004)

### 2.5.7 LCA Software

With regard to the software update we have taken a mixed approach to come up with the world map in Figure 12. In addition, to the survey results we have used the selling information from leading software developers like GreenDelta (openLCA), Pre (SimaPro) and PE (GaBi). Of course, we acknowledge that other LCA software applications exist like EIME, KLC, TEAM and Umberto (to just name a few). However, we have focused on the three mentioned above. This allowed us to cover all countries around the world where international LCA software is being used. Definitely, we can state that LCA software is currently used in all the G20 countries, Switzerland and the emerging economies of the survey with the exception of Russia. Also, with regards to the EU-28, Bulgaria, Croatia, Cyprus, Slovakia and Slovenia do not appear to use LCA software. Overall we see again that Africa, Middle East and the post-Soviet states are rather weak users of LCA software.

### 2.5.8 Policy

The survey question with regard to policies (Have life cycle approaches being used in the legislation of your country or region and if so please specify the policy area where it has been applied?) has not been able to provide meaningful results, unfortunately.

Overall we can highlight that there is a general trend towards a global use of LCA as promoted by UNEP already in its publication from the very end of the last century (UNEP, 1999). This becomes evident if we compare the results of the current 2014 survey with the results obtained by AIST in 2004. However, likewise, we can clearly identify the gap that still remains between the developed and most emerging economies with regard to the level of the LCA implementation; and then we see also that parts of the world are lagging in embracing life cycle thinking.

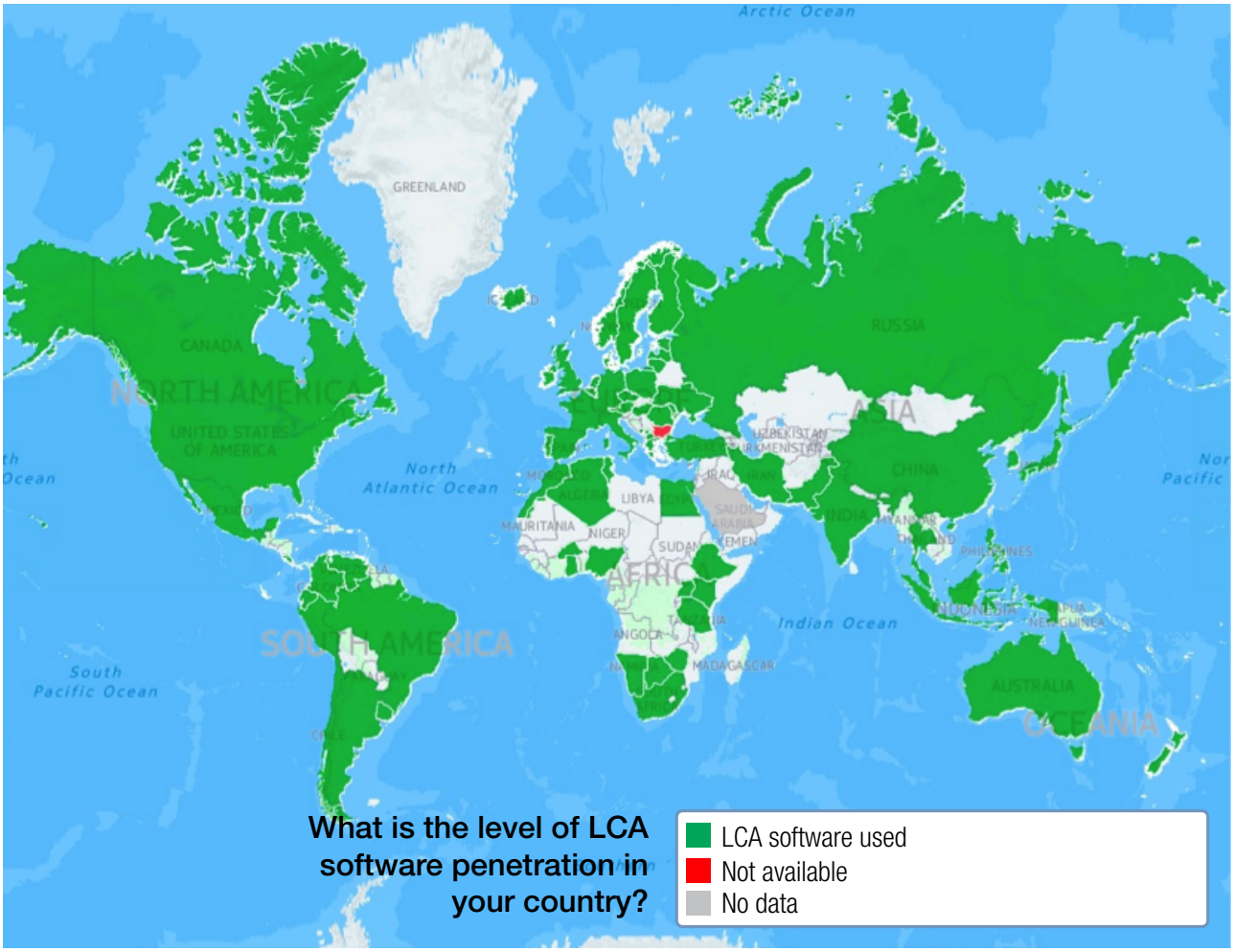



Figure 12: Software update in countries around the world according to survey and international software sales information

## 2.6 Description of networks at national level

Now the next step in our report is to understand the role of the national life cycle networks in the growth of using life cycle approaches around the world in the last 10 years. Therefore, we describe the global landscape focusing again on the target countries.

### 2.6.1 Network availability

The facts about the networks are available in the country sheets in the Annex 3. We present again world maps below based on the results of the survey, complemented with additional information if required. We compare the situation with regard to the availability of networks and databases with the survey results obtained by Sagisaka (2004) to highlight the developments in a decade.

In order to provide an overview of national life cycle networks we have taken again a mixed approach to come up with the map in Figure 13. In addition to the survey results extended to all countries, we have used the information provided on the Life Cycle Initiative website mentioned at the beginning of this chapter. In this way we hope to have been able to consider all countries around the world where a national life cycle network may exist. Comparing our results with those from Sagisaka (2004) in Figure 14 (p. 38), we can quickly observe that key emerging economies, like China and Mexico, have national life cycle networks nowadays.

Having a focus on the quickly growing and emerging economies, we can tell that only the Philippines, Egypt, Morocco, Saudi Arabia and Russia clearly do not have a national life cycle network at present. The situation in Turkey is unclear because the efforts to create a network are recent as can be deduced from the LinkedIn-based network in Turkey. In addition to those networks that are part of our list of target emerging

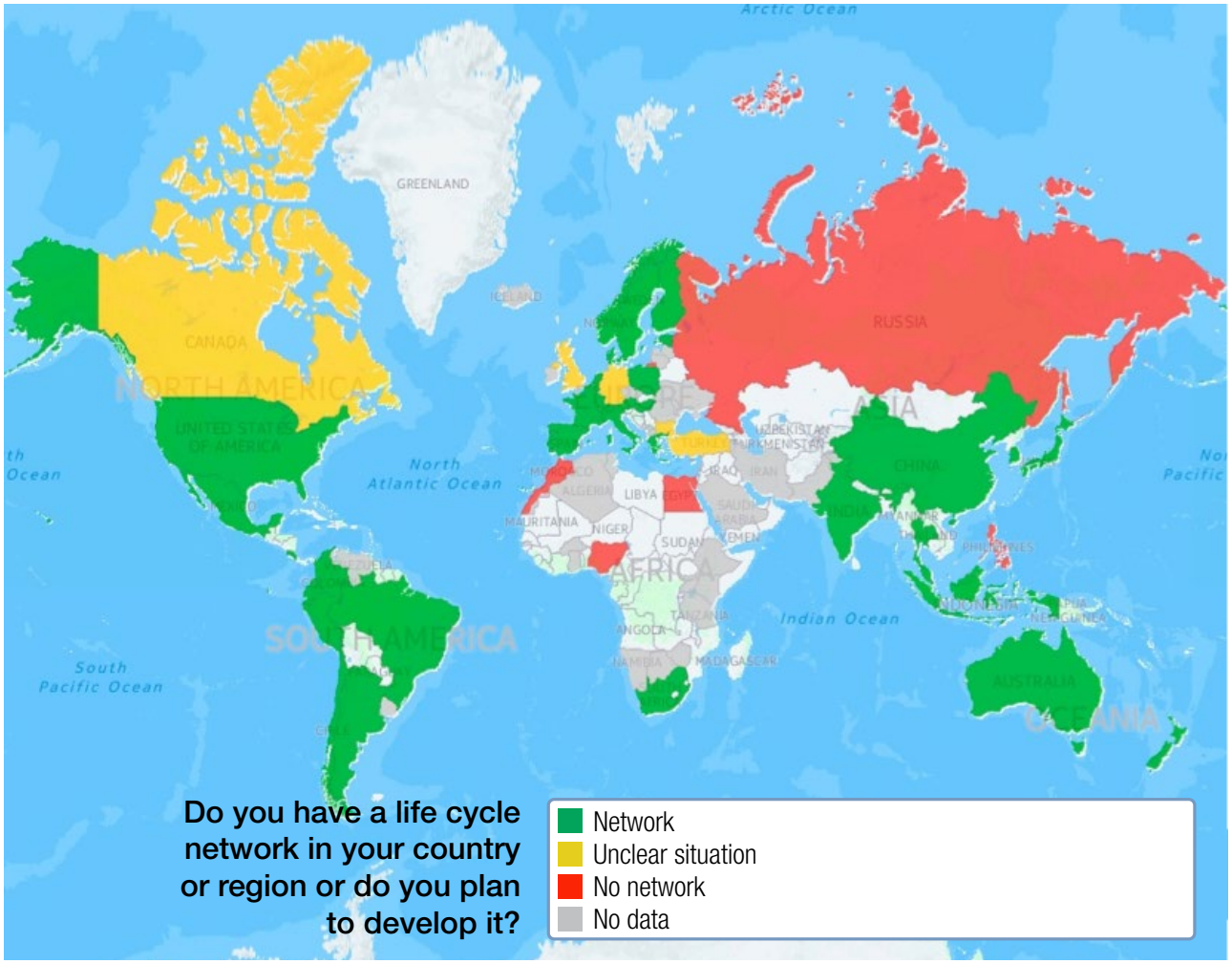



Figure 13: Availability of national life cycle networks around the world

economies, we have included national life cycle networks like in the Latin American countries of Colombia, Costa Rica and Ecuador.

The unclear network situations in the survey results in Canada, South Korea, Germany and UK might stem from the absence of an officially accepted network and/ or a competition among networks.

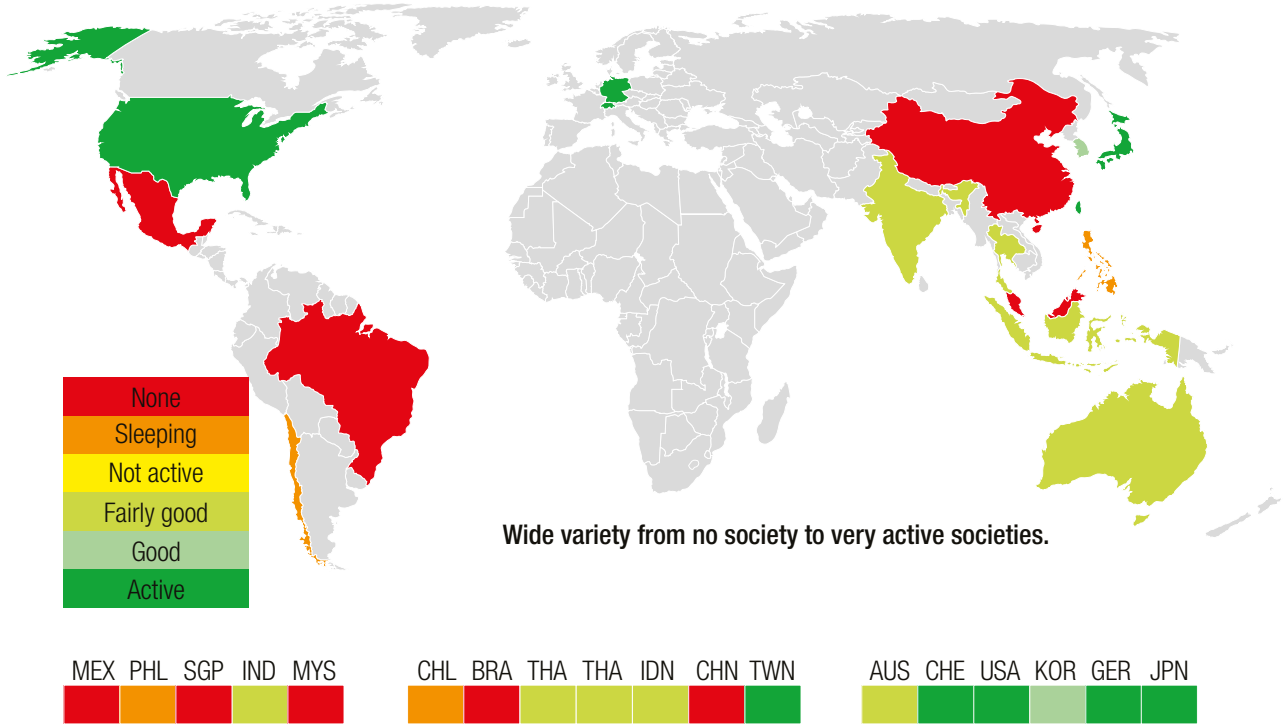



Figure 14: LCA Forum or Society in APEC countries in 2004 (Sagisaka, 2004)

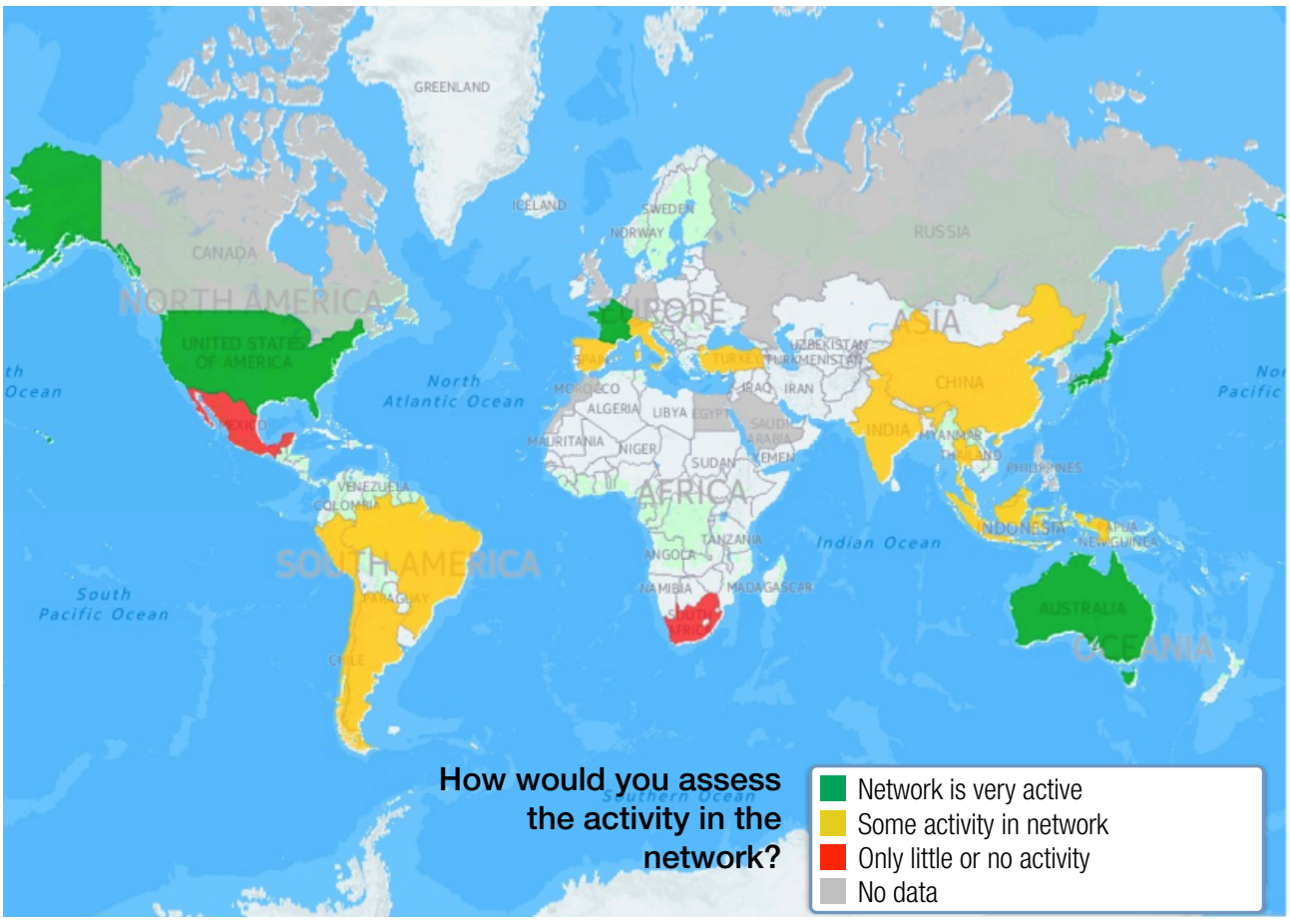



Figure 15: Activity level of national life cycle networks around the world according to survey

For instance for South Korea the Life Cycle Initiative website includes three national networks (UNEP/SETAC, 2014b). Elsewhere the survey indicates that all other developed G20 countries have (at least) one national life cycle network. Within the EU-28 we have identified 14 countries - which is half of the number of member states - with a national life cycle network, excluding the ones with an unclear situation. That is, in addition to the G20 countries (including Spain): Austria, Belgium, Denmark, Estonia, Finland, Greece, Hungary, Netherlands, Poland, Portugal and Sweden have a network. Moreover, networks are available in Norway, Switzerland and New Zealand.

This new world map allows us to better understand the situation in some countries in comparison to the UNEP/SETAC Life Cycle Initiative Networks Map in Figure 4, but it leads to the same overall conclusion. National life cycle networks are mainly still missing in Africa, the Middle East and the post-Soviet states. We could add here the Small Island Developing States (SIDS), in particular in the Pacific and the Caribbean. These are countries that are very vulnerable to climate change and might therefore be open to life cycle thinking.

### 2.6.2 Network characterization

Figure 15 shows that only the survey participants from Australia, France, Japan and the United States consider their networks to be very active. In all these countries the networks organise visible annual or biannual conferences that were previously described. Most networks are characterised by organizing some activities further described in the country fact sheets in Annex 3. Only the respondents from Mexico and South Africa tell us that their networks have little or no activity at all. In the case of South Africa, a life cycle network was created, albeit with no legal entity in 2004-2005. The associated website, which is part of the African LCA Network (ALCANET) has not been updated since 2011. In Mexico, the life cycle network has been active with an actual, dedicated website since 2011. However, the network activities seem to be limited to the organization of training and workshops.

Furthermore, we observe that most networks have no legal status (Figure 16). National life cycle networks that are set up as a legal entity are the Swiss Life Cycle Assessment Forum (LCA Forum),

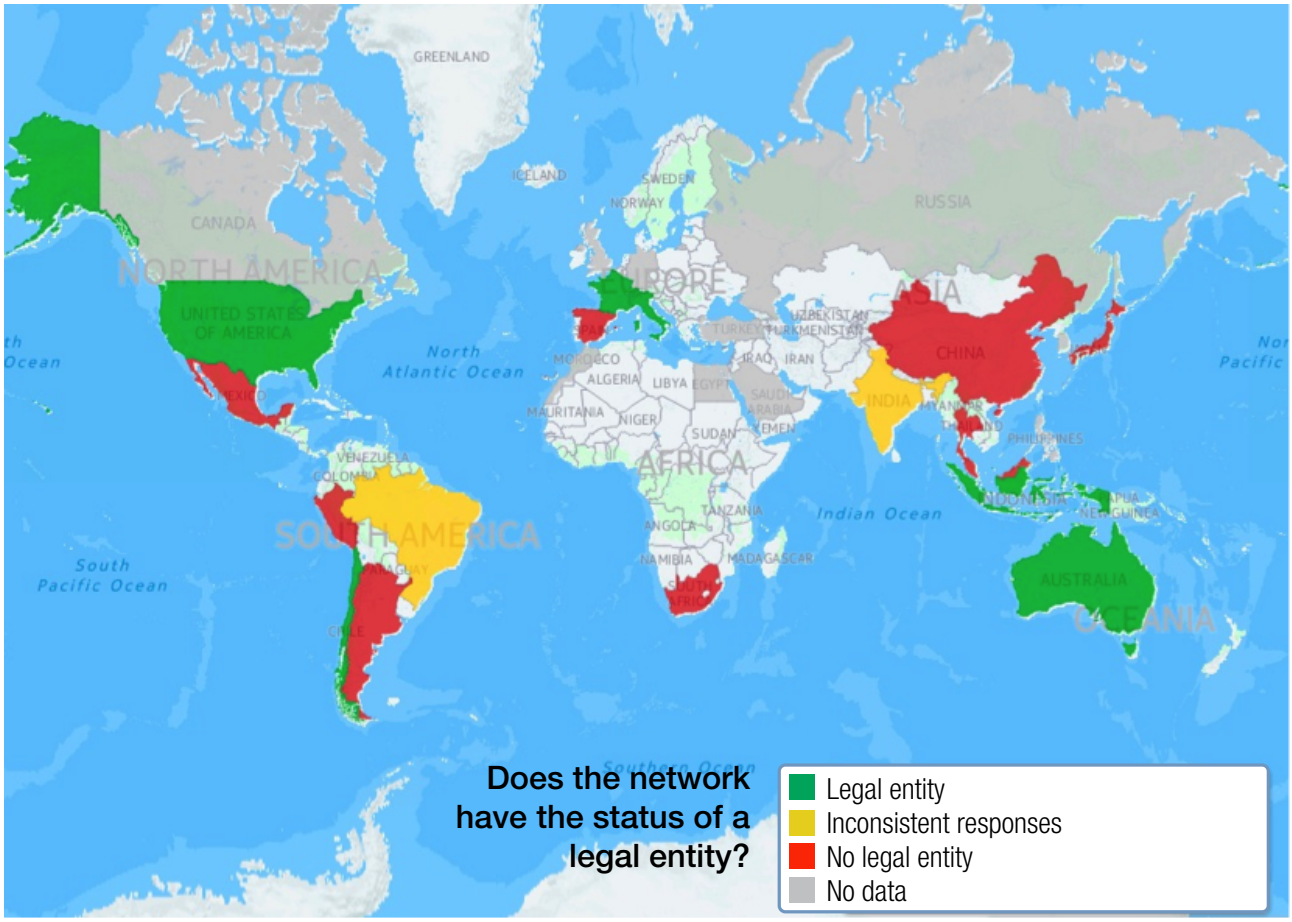



Figure 16: Legal status of national life cycle networks around the world according to survey

the Australian LCA Society (ALCAS), the American Center for LCA (ACLCA), the Indonesian Life Cycle Assessment Network (ILCAN), the Red ACV Chile (Chilean LCA network) and the Rete Italiana LCA (Italian LCA network). In France three networks exists: EcoSD Network is a French association with the main objective to encourage collaboration between academic and industrial researchers in order to create and spread advanced knowledge in the eco-design field. SCORE LCA (France) is also a French association which aims to promote and organise the cooperation between industrial, institutional or scientific actors specifically on LCA. Finally [avniR] is an initiative of the not-for-profit organisation cd2e and organises an annual conference on LCA in practice.

Clearly the size of the networks goes in parallel with its activity level. The networks, for which respondents indicate they have more than 500 members are only in the highly populated and developed countries, Japan and the United States, while France's and Swiss ranges around 250 members and Australia's somewhere below this and 100 members. Apart from these, most networks have between 10 and 50 members. In the case of the emerging economies, Thailand seems to be the one with more than 100 members, which corresponds to its outstanding status also with regard to mainstreaming. More information on the situation with regard to national networks is available in the country fact sheets.

Many of the networks are involved in or are even initiating the development of LCA databases. As we have seen, for instance, the ACLCA has a committee on the LCI database in the US, the Malaysian network was created jointly with the project on the LCA database and the India LCA Alliance is involved into plans for developing a national database.

### 2.6.3 National LCA Databases

As depicted in Figure 17, we see that all developed G20 countries plus Switzerland have created an LCA database if we consider the EU level here

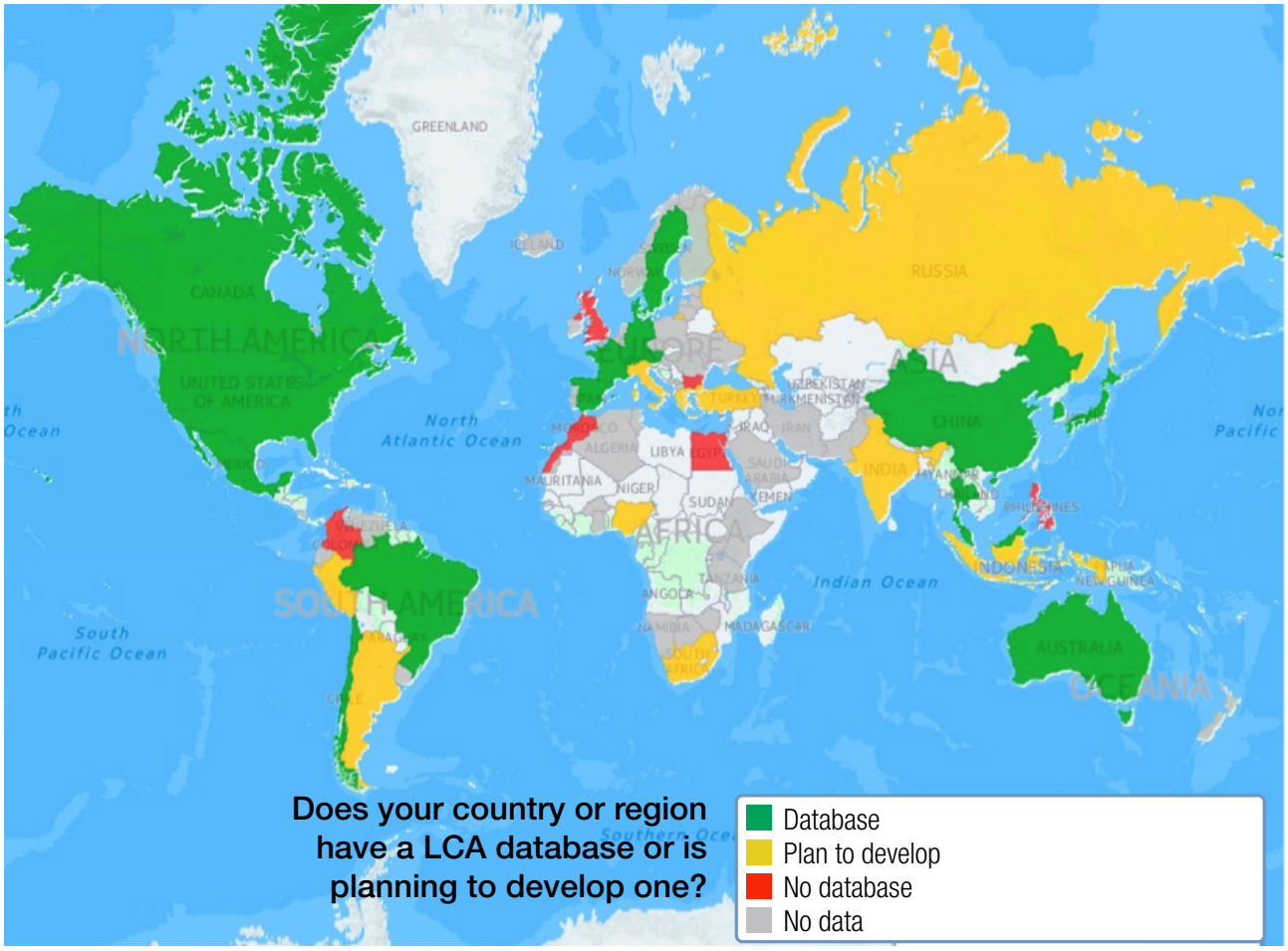



Figure 17: Databases availability in the countries around the world according to the survey and some additional information provided in chapter 3

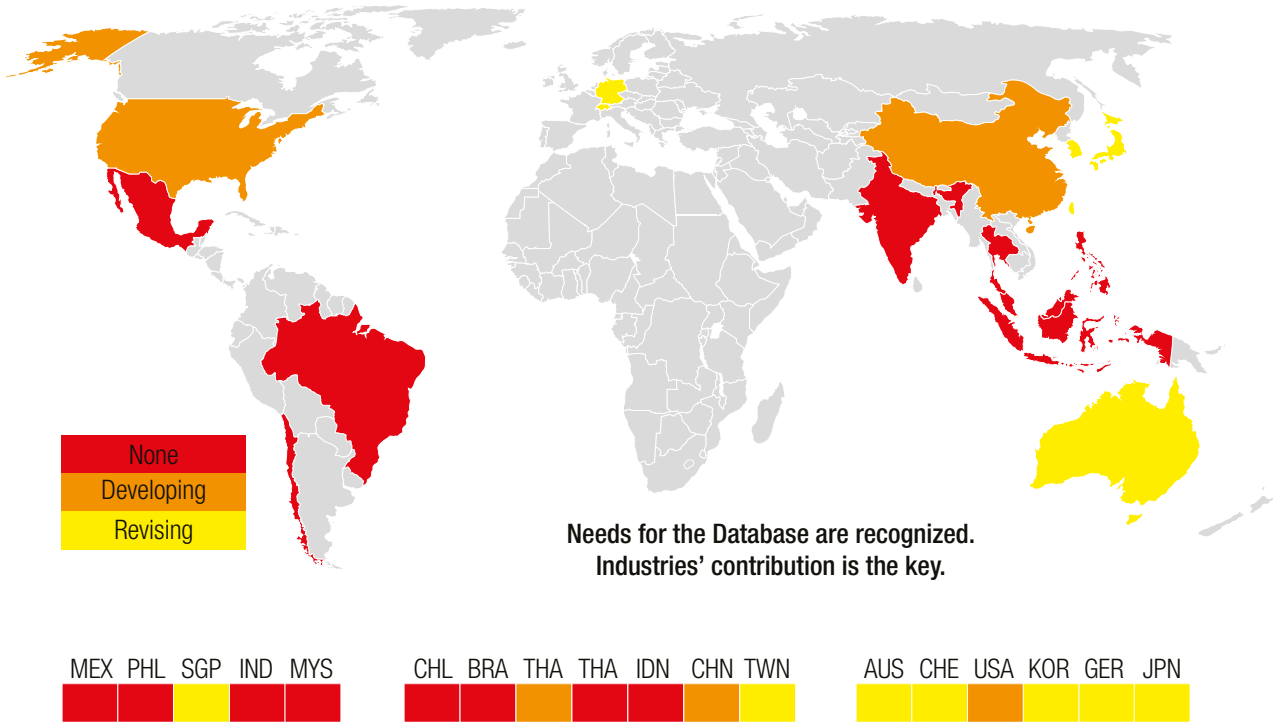



Figure 18: Public Life Cycle Inventory Databases in APEC countries (Sagisaka, 2004)

and not the member state level. With regards to emerging economies, we notice that only a few countries like Brazil, China, Chile, Mexico, Malaysia and Thailand have actually established a LCA database. However, most survey participants indicate for their country that they plan to build a database, with the exception of Egypt, Morocco, Philippines and Saudi Arabia.

Comparing these results with the situation in 2004 according to Sagisaka (2004) as represented in Figure 18, we observe a very positive development with regard to the establishment of LCA databases in all developed G20 countries, when considering the European ones together at the EU level, and in some emerging economies such as Chile, Mexico and Malaysia. Encouraging are also the plans for developing a database in key developing G20 countries, such as Russia and India and South Africa.

## 2.7 Key findings and recommendations on life cycle networks

In this section we present common trends and differences among world regions and countries with regards to mainstreaming life cycle approaches. We also summarise the findings on regional networks and finally we look at the lessons learned from this chapter for setting up and managing national life cycle networks.

In general, we can conclude that we have been able to show by comparing our survey results with those obtained by Sagisaka (2004) that within the decade from 2004 to 2014, life cycle approaches have started to become mainstreamed around the world. At the very beginning of the 21st century, Life Cycle Assessment was still a topic for a niche with a relatively small group of experts from Europe, North America, Japan, South Korea and Australia, plus a few individuals from a limited number of emerging economies. Now the level of maturity of life cycle related activities and the actors behind them has clearly and positively evolved around the world, including in most emerging economies.

At the regional level around the world, we identify that life cycle approaches have been mainstreamed at a different level of maturity in Europe and North America as well as in the developed part of Asia/Pacific than in the developing world. In particular, in Africa, the Caribbean and Central Asia, we observe a very low level of activities on life cycle approaches, while in emerging economies in Asia and Latin America, plus also South Africa and Turkey, we observe a clear uptake of these approaches by academics, consultants, industries and slowly also governmental agencies.

At the national level we can make more detailed observations, in particular for the emerging economies in Asia and Latin America. We see for example that China and Thailand, as well as Brazil and Mexico, are a bit ahead of their neighbouring countries with regards to mainstreaming life cycle approaches. However, we also have to acknowledge that we have gaps in the survey results with regards to Saudi Arabia, where we had no respondent to the survey.

Taking a look at the national life cycle networks, the survey results indicate that no national networks or activities are present in Egypt, Morocco, Philippines and Saudi Arabia. Also, in a few countries the situation with regards to their national networks remains unclear due to inconsistent responses (e.g. Turkey, Canada, the UK and Germany). As such it seems to be appropriate to organise outreach events in these countries to generate momentum toward exploring the feasibility of the creation of a clearly recognised national network.

As for the national networks that exist it is evident that those networks which are considered to be very active are also those who organise visible annual or biannual conferences. Most of these networks are also organised as a legal entity, while the majority of the identified networks do not have a legal status. It is thus clear that overall there is a huge need to strengthen life cycle networks around the world. Strengthening the networks towards establishing a legal entity also appears to be a way forward to provide more regular activities since in general the countries that have a network with a legal entity are also those with a higher activity level.

It also appears that a large number of produced LCA studies, including those from companies, in principle, only exist in industrialised countries, with the exception of Thailand. To address this situation, universities should be supported, especially in emerging economies, to carry out studies and educate the new generation of professionals so that they bring life cycle knowledge to their local companies. Moreover, multi-nationals, for instance Unilever and Marks & Spencer, could export their (corporate) expertise to their affiliates in developing countries and emerging economies. This suggestion was also supported during discussions in recent capability development events in emerging economies such as India and Turkey.

Based on this worldwide overview of regional and national Life Cycle Networks, which often are associated with the UNEP/SETAC Life Cycle Initiative, the outlined need to further strengthen existing networks and help develop new ones is clear. To facilitate this process, we have come up with a number of guiding principles and verifiable indicators which we consider essential for setting up, managing and maintaining a life cycle network:

*Transparency*

Network Information should be made available to the general public through the internet, such as via a dedicated website and/ or other social media (such as LinkedIn™ or Facebook™).

Verifiable indicator: A publically accessible website and/or other web presence, with a mechanism for contacting the owner.

*Governance*

A minimal structure, such as a coordination committee, should ideally be in place. There should be a key focal point for the network, such as an organisation, to ensure the continuation of the network in the event that an individual leaves the network. The network should be democratically organized, so that members who actively participate in the network control it and each member has equal voting rights (one member = one vote).

Verifiable indicator: Contact details (name and organisation) of responsible individuals involved in the organisation, such as the focal point or a list of members.

*Inclusiveness & Balance*

The network should encourage open participation from the LCA and non-LCA community, without discrimination. The members should ideally represent a wide range of stakeholder groups, such as government, industry (companies and industry associations), academia, LCA consultants, consumer representatives, NGO and IGO representatives. To this end, the network should consider a reasonable fee members have to pay to join, in order to ensure the equitable access of NGO and consumer representatives to the network while providing at the same time for some revenue to fund its activities.

Verifiable indicator: Information provided on membership indicates that anyone can join and details on stakeholder groups represented by members.

*Purpose - Vision/ Mission*

The network should be clear on what it is aiming to achieve in the short and medium term, which could be formalised into a mission and vision statement, objectives and related activities. This may be to advance the interests of its members, life cycle thinking or both. The overall aim would ideally be consistent with the vision that life cycle thinking is adopted in private and public policy to ensure that consumption and production are more sustainable and that adverse environmental, social and economic impacts are minimised or avoided wherever practicable. The aim/ vision/ mission statement should be consistent with the geographic scope of the network.

Verifiable indicator: Purpose of the network clearly stated on the website/web presence.

*Life cycle approaches are core business*

The network should stimulate the creation of feedback mechanisms to support the dissemination and application of life cycle thinking, and scientific research that supports the further development of life cycle thinking.

Verifiable indicator: Main activities relate to life cycle-based approaches and the website reflects this focus.

*Quality control*

The network should strive to ensure that its activities and outputs are of sufficient quality to promote the uptake of life cycle thinking.

Verifiable indicator: Outputs are of good quality. It is recommended that each network sets up a review committee to ensure the quality of its outputs.

*Co-operation with other networks*

The network should look for opportunities to work with other networks on a local, national, regional or global basis, to advance the cause of life cycle thinking.

Verifiable indicator: Cooperations established with other networks.

We consider these guiding principles for national life cycle networks, which are in line with the life cycle networks criteria put forward by Bjørn et al (2012), key elements that can help other countries to build networks that function well. We will use them in chapter 4 for the assessment on opportunities for further life cycle networks creation, interlinkages and strengthening around the world.

# 3. Overview of Global Life Cycle Inventory databases

Along with the previously described uptake of Life Cycle Thinking and Life Cycle Approaches around the world, the number of life cycle inventory databases is also growing. In addition, the diversity of databases is also increasing with regards to supported formats, content, and addressed audience. The following chapter provides a mapping of different and currently existing databases.

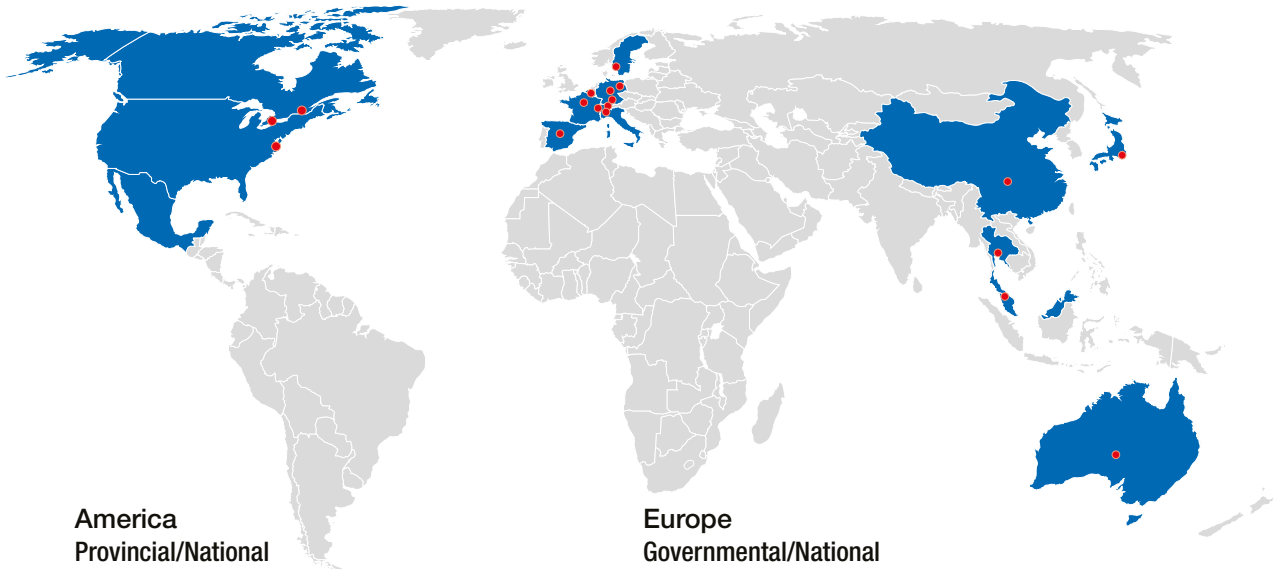
## 3.1 Background and motivation

The provided list of databases contains some of the most relevant LCA databases worldwide (cf. Figure 19); however, it cannot claim to be complete. Sources were web search, own information and direct contacts, and some other existing compilations of LCA databases, as for example the Greenhouse Gas Protocol website [GHG protocol 2012]. Unfortunately, due to time restrictions, it was also not possible to interact with every database operator directly.

Every database is provided by an institute or organisation, which we refer to as the database provider. Database providers often offer several databases with very similar characteristics but e.g. different industrial sectors covered. Therefore, the description and characterisation is structured according to database providers rather than to databases.

One interesting aspect of attention was the interoperability and availability of databases in different LCA software systems, as highlighted in previous chapters.

The Shonan Guidance Principles text [Sonnemann and Vigon 2011] distinguishes databases from libraries, the latter being "A collection of stored datasets or records about datasets" with "Limited /partial or inconsistent documentation". A typical example for a library would be the German ProBas



**America**

**Provincial/National**

- CIRAIG/ecoinvent Center, Canada, Quebec LCI database
- NREL, USA, U.S. LCI Database
- University of Waterloo, Canada, CRMD

**Asia**

**Governental Bodies/National**

- Environmental Technolgy Research Centre, Malaysia, MYLCID
- AIST/JEMAI, Japan, IDEA
- NSTDA, Thailand, Thai National LCI Database

**Private research/consultants**

- Sichuan University, IKE Environmental Technology Co., China CLCD

**Australia**

**National**

- Australian Lifecycle Assessment Society, Australia

**Europe**

**Governmental/National**

- ADEME, France, Agri-BALYSE
- European Commission's JRC-IES, Europe, ELCD 3.0
- Federal Ministry of Transport, Building and Urban Development, Germany, Ökobau.dat

**Public/State-driven**

- BioEnergieDat-Project BioEnergieDat, Germany
- New Energy Externalities Developments for Sustainability Project, NEEDS
- Umweltbundesamt, Germany, ProBas

**Public-private partnerships/Institutions**

- CPM-the Swedish Life Cycle Center, Sweden, SPINE@CPM
- ESU-services Ltd., Switzerland, LC-inventories.ch, private-public
- Sostenipra, Sudoe Area, LCADB.sudoe
- Swiss Centre for Life Cycle Inventories, Switzerland, ecoinvent
- Consorito por La Sustainabilidad

**Private consultants/industry**

- Thinkstep, Germany, GaBi LCA Databases
- Quantis Switzerland, Switzerland, Quantis Water Database

Figure 19: Database providers worldwide

| Name | Country (database creator) | Dataset Review (internal or external) | Number of datasets total | Number of datasets public (free or for purchase) | Database/ Library | Database/ Library Type (national / regional / public-private / private) |
|---|---|---|---|---|---|---|
| Agri-BALYSE | France | | 822 | 822 | Database | national |
| Australian Life Cycle Inventory Database (AusLCI) | Australia | X | >150 | >150 | Database | national |
| BioEnergieDat | Germany | X | 178 | 178 | Database | national |
| Quebec LCI database | Quebec, Canada | X | 900 | 900 | Database | public-private |
| SPINE@CPM | Sweden | X | >740 | >740 | Database | public-private |
| Ecobase | Chile | x | 147 | 147 | Database | national |
| MY-ILCD | Malaysia | X | 160 | 0 | Database | national |
| extensions of ecoinvent data v.2.2 | Switzerland | X | 6841 | 6841 | Database | public-private |
| ELCD 3.0 (European Life Cycle Database) | EU | (ongoing) | 334 | 334 | Database | regional |
| Ökobau.dat 2014 | Germany | X | 954 | 954 | Database | national |
| Inventory Database for Environmental Analysis (IDEA) | Japan | X | 3000 | | Database | national |
| U.S. Life Cycle Inventory Database | USA | | 880 | 880 | Database | national |
| Thai National Life Cycle Database | Thailand | X | 1300 | 0 | Database | national |
| NEEDS | International | X | 187 | 187 | Database | regional |
| GaBi LCA Databases 2013 | Germany | X | 6513 | 6513 | Database | private |
| Quantis Water Database | Switzerland | X | 4000 | 0 | Database | private |
| Chinese Life Cycle Database | China | | 600 | | Database | private |
| LCADB.subdoe | Catalonia, Spain | X | 72 | 19 | Database | public-private |
| ecoinvent v3.1 | Switzerland | X | 11302* | 11302* | | public-private |
| ProBas | Germany | | >8000 | >8000 | Library | national |
| Canadian Raw Materials Database (CRMD) | Canada | | 18 | 18 | Database | national |
| Banco Nacional de Inventários do Ciclo de Vida (SICV) | Brazil | x | 10 | 10 | Database | national |
| Mexicaniuh | Mexico | x | 81 | 81 | Database | private |

Table 3: Overview of databases and libraries

"database", provided by the German EPA (http://www.probas.umweltbundesamt.de). While this distinction is still valid, a third variant has emerged meanwhile: A network of connected and consistent databases, with currently two examples, the openLCA nexus and the data network of ELCD. This will be addressed in the following text under the headline "data hub / networks".

To be included in this overview, the following conditions had to be met:

- The database covers more than the flows associated with one-single impact category (e.g. on GHG, which are more widespread especially in the emerging economies such as Morocco or India),
- the database is available, and
- to avoid double counting of processes, smaller databases, already embedded in the ones researched on, are not listed again.

## 3.2 Database providers

The different database providers are listed in Annex 4. For each database provider always the same template is used, empty fields indicate missing information.

The information shows that many different databases exist, worldwide, also in different countries. There are also more and more databases which are specialized in certain sectors or in specific products, e.g. from the food sector.

Table 3 lists the different databases that are summarized in the annex, with a focus on the country or region of the database provider and the number of data sets in each database, available in principle and the number of datasets available publicly. For some of the databases, both figures are different, as a subset of datasets may be available only to a group of project members for example. Empty cells indicate that information was not available. The table shows that databases differ quite a lot with regards to the amount of data sets they provide. Some databases consist for example of less than 20 data sets. On the other side, the sheer number of data sets does not completely explain how comprehensive a database might be, as for example one parametrized data set in one database can be equivalent to several hundred data sets in another database that are not parameterized.

A second aspect shown in the table is that almost all databases listed perform a review of their data sets before they are published, or are in the process of reviewing data sets.

## 3.3 Data hubs and networks

A data network is composed by more than two initiatives aiming at interlinkages to improve the management of data. A data hub is an access point which provides a collection of data from different providers. Data hubs and networks have emerged rather recently; they aim to combine different databases, from different data providers, in one system.

In the traditional way, users can get access to databases by acquiring the associated data with software packages such as GaBi, SimaPro and Umberto to name the main ones in alphabetical order.

In addition to the traditional way, several other ways already exist or are emerging for data access. For example, an intergovernmental network is developing the Global LCA Data Access (GLAD) Network as a product to be established in 2017 with the mission of supporting data nodes from around the world to supply datasets of defined characteristics (via consistent metadata descriptors) to the user community. Although the network is being established as an intergovernmental partnership under the auspices of UNEP, provisions allow both public and private entities to establish nodes on the system. Another already existing international network is the ELCD data network, which was launched officially on February 2014 and is described in more detail below.

Another open access distribution mechanism will exist through the BONSAI network. As described in a recent talk at the SETAC Europe meeting in Nantes, the BONSAI database (https://bonsai.uno) is an open source community initiative, using semantic web technology and data harvesting to increase free access to structured LCI data. The core database is implemented as an RDF store. The RDF store is designed for storing supply-use (input/output) data, defined as a flow-by activity matrix for the balanceable properties of flows

between activities, further specified by location, time and macro-economic scenario (relevant for forecasted data). Each data point consists of a value together with an unit and an uncertainty estimate. Non balanceable flow-properties and metadata can also be stored with the supply-use framework. A separate matrix can store information on complementary and substitutability between products. Besides the core database, BONSAI will store algorithms and software code for estimating missing data, automatic data harvesting and accessing and data manipulation. In addition to BONSAI, another open access distribution mechanism is the openLCA nexus data hub, which is also described in more detail below.

### 3.3.1 EPLCA - Life Cycle Data Network [data network]

#### Overview

- **Name**: EPLCA
- **Website**: http://ilcd.jrc.ec.europa.eu/ILCDRegistry/pages/home.xhtml/
- **Provider**: JRC
- **Contact**: http://eplca.jrc.ec.europa.eu/?page_id=960
- **Released/ last updated**: 6 February 2014, since then growing; information below assessed per 23 March 2015
- **Principle**: different connected nodes, access via http://ilcd.jrc.ec.europa.eu/ILCDRegistry/pages/newnodes.xhtml. The current nodes are:
  a. ELCD (http://eplca.jrc.ec.europa.eu/ELCD3/: 496 datasets
  b. PlasticsEurope (http://plasticseurope.lca-data.com/ILCD/: 10 data sets
  c. Italian National LCI Database: http://lci-ilcd.bologna.enea.it:8080/Node: 2 data sets (Mai 2014); as per today, the node is not accessible any more
  d. CLCD (Chinese Core Life Cycled database), http://clcd.itke.com.cn:8080/Node/: 634 data sets as per May 2014; at present, the node is not accessible any more
  e. Cycleco: http://ilcd.cycleco.eu/textile/: 0 data sets (May 2014: 36 data sets)
  f. Apeal: http://79.174.135.45:8080/Node/: 2 data sets
- **Data language(s)**: Mostly English, Chinese (depending on the node)

#### Access – Download formats and accessibility

- **File type**: ILCD 1.1 data format
- **Compatible software**: Software that is able to read ILCD, e.g. GaBi, openLCA, SimaPro (after conversion)
- **Accessibility**: Some datasets are directly available, some require registration; all are at present for free.

#### Content

- Aim is to have a network of databases that all fulfill the same entry level requirements for datasets (http://eplca.jrc.ec.europa.eu/?page_id=134). An assessment of the entry level fulfillment is currently ongoing.
- Based on ISO 14040/14044: yes

### 3.3.2 The openLCA data nexus [data hub]

#### Overview

- **Name**: openLCA nexus
- **Website**: https://nexus.openlca.org/
- **Provider**: GreenDelta, www.greendelta.com
- **Contact**: gd@greendelta.com
- **Released/ last updated**: 2013-05-01 since then constantly extended
- **Dataset number**: 69,092 in various databases:
  - ProBas: 29369
  - Ecoinvent: 15416
  - LC-Inventories.ch: 6841
  - GaBi: 6513
  - Social Hotspots: 6356
  - USDA: 2122
  - Ökobaudat: 954
  - Agribalyse: 822
  - ELCD: 334
  - NEEDS: 187
  - Bioenergiedat: 178
- **Licensing**: depending on the licence condition of the database; some for free, some for purchase
- **Data language(s)**: English, German (depending on database)

#### Access – Download formats and accessibility

- **File type**: “olca packs” and zolca files (openLCA-specific formats), SimaPro csv
- **Compatible software**: openLCA, some databases also SimaPro

Content

- All databases have a common reference flow list and are slightly refactored so that they can be combined and integrated into one model;
- one common, comprehensive LCIA method pack with all major LCIA methods
- data sets are available from a website, users can look for required data sets via a search engine on the website
- Based on ISO 14040/14044: yes

## 3.4 Additional Information

In a report (Wolf 2014) that was produced independently from the UNEP/SETAC Life Cycle Initiative, a survey was performed among different LCI databases worldwide. Not all major databases were able to reply, for example the ecoinvent database is missing in the survey. However, some results are interesting and are therefore added here. For details, we would like to refer to the original report, (Wolf 2014).

Some key findings are:

- only a small percentage of the replying databases use LCI databases as background datasets; more frequently, generic data sets are adjusted (cf. Figure 20)
- EcoSpold and ILCD data formats are used more or less as frequently (cf. Figure 21)

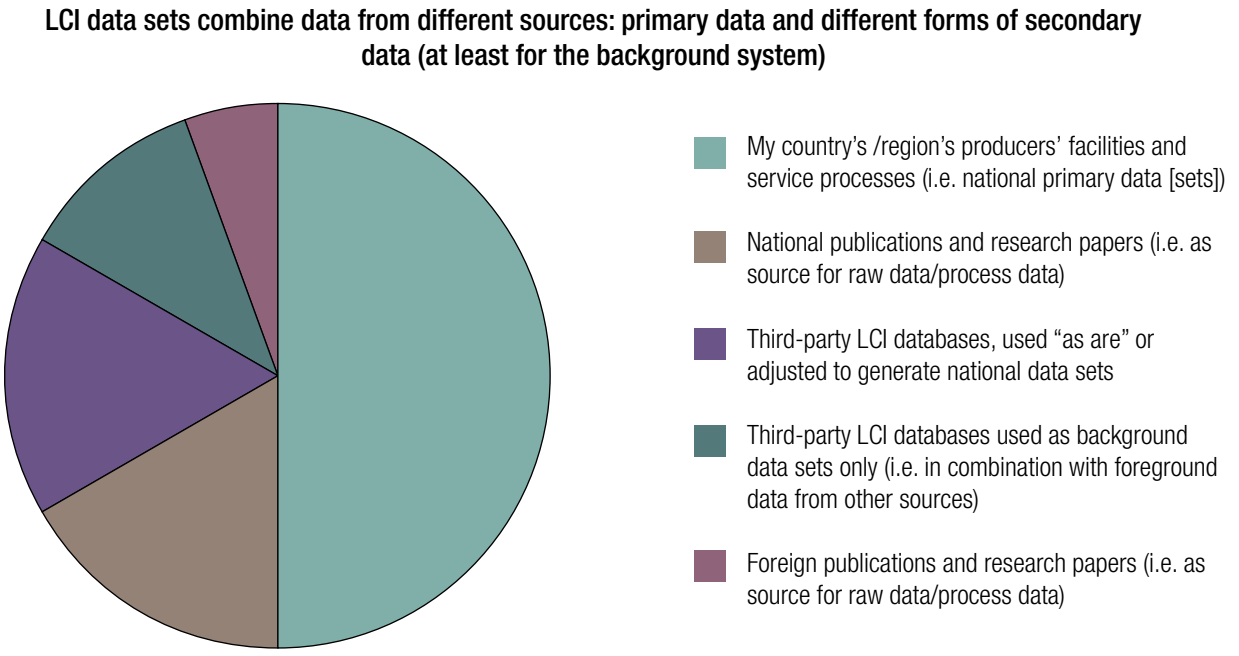



Figure 20: Answers to the use of different databases when creating data sets (Wolf 2014)

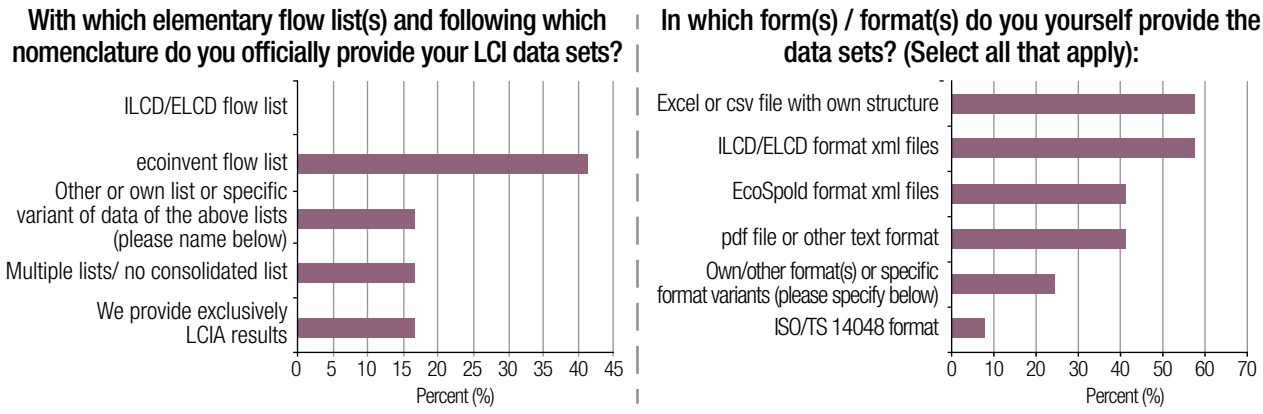



Figure 21: Answers to the used format of datasets (Wolf 2014)

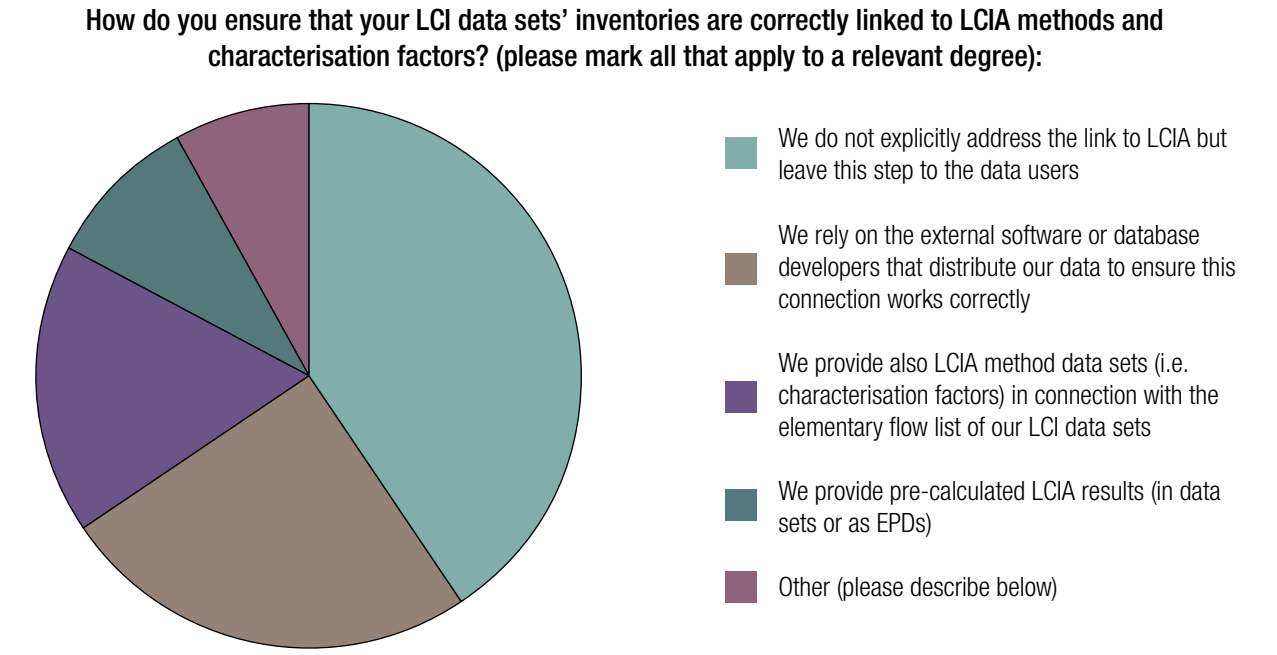



Figure 22: Answers to the linkage between LCI and LCIA (Wolf 2014)

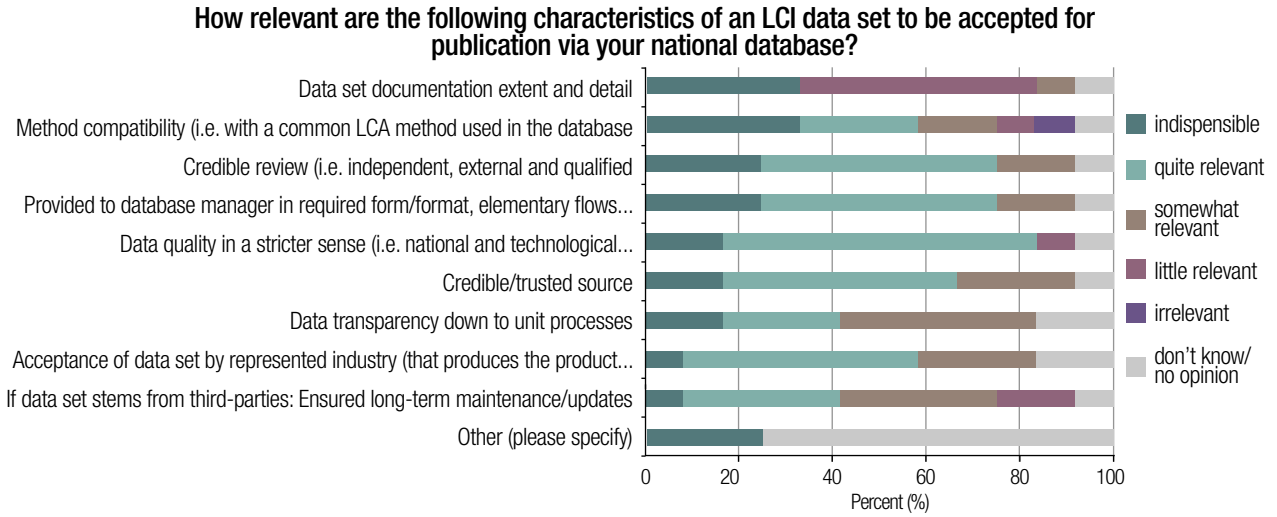



Figure 23: Answers to characteristics of LCI data sets regarding national databases (Wolf 2014)

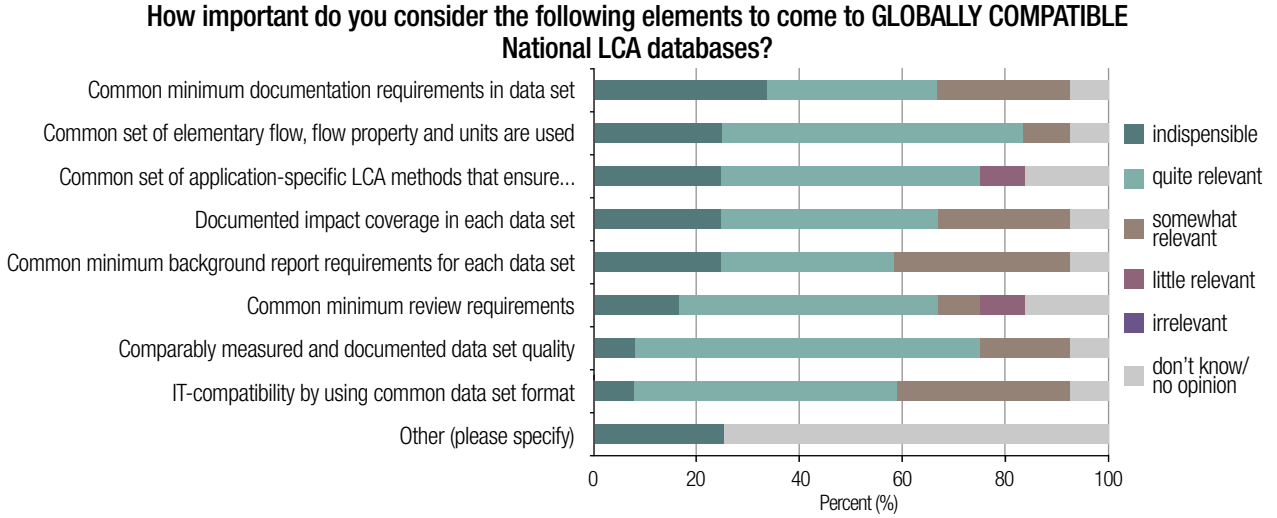



Figure 24: Answers to important elements for globally compatible LCA databases (Wolf 2014)

Q23: "Number of data sets of different types in your database. Please give rough numbers; enter "0" if none": About 40% of the national LCA databases provide exclusively or predominantly full or partly aggregated data sets, another 40% exclusively or predominantly unit process data sets, the other databases have a combination of unit process and aggregated data sts, and one database provides exclusively LCIA results.

Q28: "Which extent of data set specific documentation do you provide (i.e. next to method and other general reports)?": 2/3 of the databases provide "comprehensive documentation in the data set but no or short external report" and another 25% provide in addition a comprehensive external report.

Q29: "In which language(s) is/are the majority of the data sets accessible/available?": With one exception, all databases offer an English "Database access/ interface language(s)" and English "Core information (i.e. data set name, country/region, flow names, units) language(s)". In several cases, the data is available also in the national language, often usin multi-language capabilities of e.g. the ILCD data format.

Figure 25: Questions 23, 28 and 29 of the survey on national LCA databases (Wolf 2014)

- The link between LCIA and LCI is surprisingly little considered (cf. Figure 22)
- Method compatibility is less relevant than data set documentation (cf. Figure 23 and Figure 24)
- For details, please see the following figures and questions (cf. Figure 25).

## 3.5 An interactive map for LCA databases and datasets worldwide

An interactive map has been implemented which displays the number of data sets available worldwide, on a map. The map was implemented in the openLCA nexus system, in the course of this project, and is available here: https://nexus.openlca.org/map. Later on, the plan is to integrate the map into the website of the UNEP / SETAC Life Cycle Initiative.

Users can narrow down the displayed data sets, selecting only one type of the databases (e.g., only LCI database, omitting IO databases and libraries

Figure 26: Interactive map with LCI data sets worldwide, as implemented in openLCA nexus [openLCA Nexus 2015]

as “not claiming to be consistent databases”). A checkbox “only exact matches” shows only those data sets which are exactly provided for one country (in contrast to “global”, “Europe”, or similar).

A click on the country links to the list with the different data sets (Figure 28). This list can then be further refined, e.g. by selecting specific sectors and categories for the data sets.

Figure 27: Interactive map with LCI data sets worldwide, only exact matches and only LCI databases [openLCA Nexus 2015]

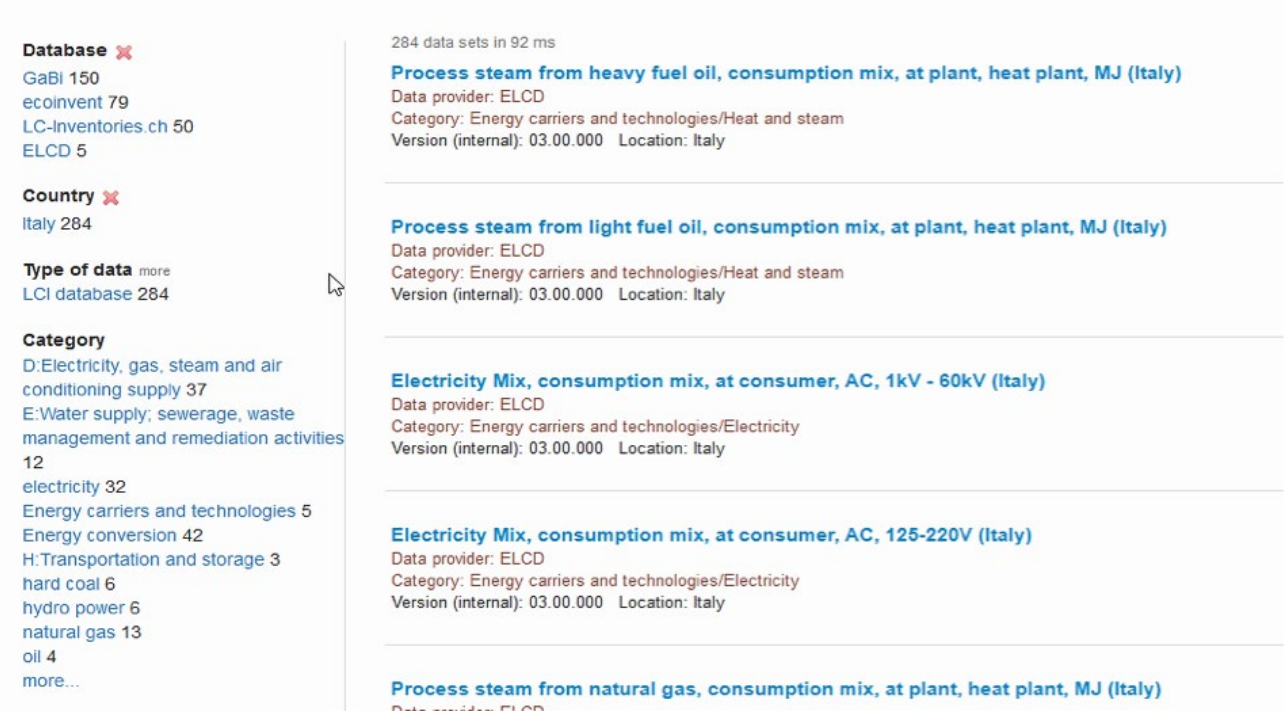



Figure 28: List of data sets provided by clicking on the interactive map; example: only LCI databases, Italy [openLCA Nexus 2015]

# 4. Assessment of opportunities for further life cycle networks creation, interlinkages and strengthening around the world with a focus on LCA database development

This chapter presents opportunities for further life cycle networks creation, interlinkages and strengthening around the world, with a focus on LCA database development. In order to have a consistent approach for the identification of these opportunities with regards to the different countries considered and the various world regions, we have developed an assessment matrix. Especially the gaps within the global landscape with regard to life cycle networks and LCA databases are discussed, followed by an overview of general options and some concrete recommendations for next steps.

## 4.1 Opportunities for the creation, growing and strengthening of national and regional life cycle networks with a particular focus on LCA database development

Taking into account the previously described survey results which have been discussed in chapter 2 and visualized in the assessment matrix (see 2.5.1), there appears to be a general relationship between countries with (active) networks and databases, and especially between countries with networks that have a legal entity and databases. The countries that have a network with a legal entity, i.e. Chile, Australia, United States, France are also the ones which have a database. Evidently, in some countries such as Chile the database effort is undertaken independently from the Chilean LCA network. However, we could still say that having a life cycle network of a certain maturity significantly increases the likelihood of having a LCA database.

Moreover, we see that the countries that do not have any life cycle network usually also do not have a plan to develop an LCA database, with the exception of Russia. Hence, we can conclude that having a network in place, ideally with a legal entity that ensures ongoing support, is a first, important step to create a plan for a database in a country.

Evidently, if there is no (active) life cycle network, international efforts should facilitate its creation or reactivation. The approach includes also the need to explore funding opportunities from development aid and other public sources as well as from industry and not-for-profit foundations and similar organisations. Tapping into various funding sources will become important as the survey results indicate that funding of up to US$ 1,000,000 is considered to be needed also for existing networks to move from one maturity level to another and thus enabling networks to increase their activities and services.

In countries where national networks do not already exist, efforts should focus first on promoting Life Cycle Management to generate the demand for life cycle based information. At the same time trainings around the general concept of LCA and water or carbon footprinting should be offered, which ultimately will generate the motivation for a national life cycle network and LCA database.

With regards to those networks that have been identified in chapter 2 which are not considered to be very active, support should focus on facilitating the knowledge and experience sharing with more matured networks. Also, given that annual or biannual conferences seem to be a good way to raise a networks' activity level, support for organizing such a conference could also be provided. These events could also be used to bring in international experts that could provide trainings and workshops on specific topics relevant to the networks' members.

In parallel to supporting the creation, growing and strengthening of national networks, training on databases should be provided to regional stakeholders so that experts are available when the motivation for a national database arises. As such work to supply datasets to a Shonan Guidance Principles conforming national LCA database should be supported.

As a general strategy regional clusters should be supported that could reinforce and strengthen national developments and focus on the creation of national and or regional life cycle networks. Regional clusters in this context refers to neighbouring states where developments around life cycle databases in one country could lead to the development of similar activities in another. Beyond strengthening these networks in its ambitions and capabilities and interlinkages on a regional level, they will also need to be connected as far as possible to the international level.

Taking these considerations into account, it is clear that there are a number of opportunities for the creation of new life cycle networks, especially in the emerging economies considered in the survey, and around the world:

- In Egypt, Morocco, Philippines and Saudi Arabia as well as Turkey, outreach events could be organised to start a process that could support the creation of a national life cycle network in each of these countries. In this context one could for example work together with ISO, which is planning to organize LCA trainings in the Middle East and North Africa (MENA) region.
- New networks should be build around a set of guiding principles for setting up and managing life cycle networks, which have been developed as part of this report and focus on the following key elements: Transparency, Governance, Inclusiveness & Balance, Purpose - Vision/ Mission, Life cycle approaches as core business, Quality control, Co-operation with other networks.
- The mainstreaming momentum of life cycle approaches in certain countries, as documented by the positive answers to most survey questions, like Argentina, Brazil, Thailand and Mexico could also be used for creating a life cycle network in their respective regions, following the Anchor Countries approach to Global Development defined by the German Federal Ministry for Economic Cooperation and Development (BMZ 2015). In the same way efforts focusing on Saudi Arabia could cover at the same time other countries in the Gulf region.
- Fact-finding missions could be funded to carry out awareness-raising on life cycle thinking and one could start exploring who could be a pioneer in promoting life cycle approaches in the countries of the regions of the world that are mostly missing such networks at the moment, i.e. Africa, Middle East and the post-Soviet states. This could for example be Rwanda in Africa and Turkey for the Middle East, where trainings have already been conducted in the past.

The survey has also provided important information on a number of countries (Argentina, Peru, India, Russian Federation, South Africa, Turkey and Indonesia) that are currently planning to develop their own national LCA databases. The efforts in these countries should be supported by providing:

- Training on the Global Guidance Principles for LCA Databases, also known as the Shonan Guidance Principles (UNEP 2013). The principles represent a global consensus on database development and training could therefore ensure that the new databases are compliant to the principles. The training could also be followed by a roadmap exercise on the way forward to establish the actual database.
- Technical assistance could have the form of developing and/or reviewing a limited number of Life Cycle Inventories (LCIs) of core products that are put in the public domain to kick-start the development of a national LCA database in a consistent way.

Beyond helping the development of national networks and databases, a number of opportunities to grow and strengthen national life cycle networks, especially in emerging economies, have been identified:

- Outreach efforts to national business and industry stakeholders could help create the demand for life cycle based information, which ultimately would generate the motivation for a national LCA database.
- Supporting existing or new networks towards establishing a legal entity also appears to be a useful way forward to ensure that more regular activities are taking place and that a national database is developed. Even if local conditions were to provide obstacles to the creation of a legal entity, some sort of formalization of a networks seems desirable as one can conclude from the survey that stronger networks and especially those backed by a legal entity also provide a higher level of activity.

That means that multiple options exist to build and strengthen networks through adequate actions, such as through the provision of trainings and relevant material and experiences. In order to make this happen, seed funding is required which could come also from international donors.

Finally, in those countries where databases already exist, these databases could become the lighthouses for other LCA database efforts around the world, if they were supported as much as possible. To this end both, creators of new

databases as well as those managing existing ones could be offered training on the Shonan Guidance Principles. In addition, technical support could be provided for instance by helping in the review of already existing datasets, which is usually an expensive exercise if international LCA experts are to be engaged to increase the credibility of the database. Concrete examples of where and how the outlined recommendations have been applied in the past are outlined below:

- A fact-finding mission to the Federation of Indian Chambers of Commerce and Industry (FICCI) in 2011 laid the foundation for the creation of the India LCA Alliance that now is organising the annual Indian LCM Conference (ILCM) and plans to develop an LCA database. As part of ICLM 2012 workshops were organised in parallel on LCA database development and LCM capability maturity model to strengthen not only the supply but in particular also the demand side for life cycle approaches.
- Following-up on training on LCA databases in Brazil in 2014, which was organised back to back to the Brazilian LCM Conference by the Brazilian Association for Life Cycle Assessment (ABCV), an agreement was reached to put LCI data on 10 core products/ services in the Brazilian national database.
- Training on the Global Guidance Principles for LCA databases in South Africa in 2015, followed by a national roundtable to define a roadmap towards a national LCA database, identified the need for a strong cooperation in the national LCA community, and hence the compelling need for strengthening the South African LCA network.
- Discussions with the manager of the Malaysian LCA database in the context of a Global Guidance Principles training in 2014 highlighted the need for technical assistance by the review of a limited number of datasets of core products and services that are put in the public domain to kick-start the development of a national LCA database in a consistent way.

## 4.2 Next steps

In order to make the maximum out of the identified opportunities, a few next steps are presented below that would allow to convert the ideas into concrete actions over the short and medium term. The following next steps track the flow of opportunities as identified before:

- Organise outreach events with academic and private sector partners and government representatives, especially in Morocco and the Philippines to explore the potentials for the creation of a national life cycle network in each of these countries,
- Work with existing partners in Thailand to organise a joint event with stakeholders from other Southeast Asian countries with the objective to stimulate interest in life cycle approaches and a national network,
- Organise a fact-finding mission to Saudi Arabia and other countries in the Gulf region to raise awareness on life cycle approaches and to discover the opportunities for the creation of a life cycle network in this part of the world,
- Explore options for other missions in a region of the world that is mostly missing life cycle networks at the moment, for which funding from inter-governmental organizations is normally more accessible, i.e. Africa and the Small Island Developing States,
- Organise training on the Global Guidance Principles for LCA databases for those countries that plan to develop a database but did not have the training yet, i.e. Argentina, Peru, Russian Federation and Indonesia,
- Support the development or revision of LCA databases with technical assistance for those countries that plan to do so and had already training on the Global Guidance Principles for LCA databases, i.e. Brazil, Chile, India, South Africa and Turkey, by negotiating with those that have data from LCA studies to put a limited number of datasets of core products and services in the public domain to kick-start the development of a national LCA database in a consistent way,

- Provide training on life cycle management to the existing life cycle networks jointly with the training on the Global Guidance Principles for LCA databases for instance in Argentina and Peru in order to stimulate the demand side as well,
- Use elements from the existing LCA databases as lighthouses for other LCA database efforts in emerging economies in the Global Guidance Principles training material,
- Strengthen the life cycle networks in those countries that plan to develop a LCA database by adequate actions, jointly with the training or technical assistance events for instance in South African and Turkey, and
- Provide technical support for example to the Thai and Malaysian LCA databases by offering the review of datasets and extend this to the databases that exist or are under construction in other emerging countries.

In order to ensure that sufficient funding can be secured for the suggested next steps, the ideas will have to be further developed and translated into concrete project proposals. Possible funding agencies are international and national donors, such as the European Commission or the French government, development banks such as the Asian Development Bank or the Inter-American Development Bank, and other public sources such as the US States Agency for International Development (USAID) or the Japan International Cooperation Agency (JICA). In addition, industry partners could be engaged for example through associations such as Worldsteel or the International Petroleum Environmental Consortium (IPEC). Also, some multinational companies such as BASF or Unilever and not for profit foundations such as the Rockefeller Foundation or the United Nations Foundation might be interested in supporting the outlined way forward.

# 5. Conclusions and perspectives

The survey and this report have shown that life cycle approaches and concepts are increasingly applied globally, new networks and stakeholders are emerging on a national, but also on an international level, as are national life cycle databases being developed. This has been shown by comparing the global survey results obtained in 2014 with those obtained by Sagisaka in 2004. As such we can clearly see a positive trend with regards to the mainstreaming of life cycle approaches around the world.

National life cycle networks need to be supported in order to enable them to become a key driver in mainstreaming life cycle approaches and thinking in their respective geographies. The more active they become, the more likely is the creation of a national database, which is needed to support decision-makers on national and global level in policy and business contexts with a reliable life cycle based information.

Efforts should be focussed on a number of countries were national networks need to be further strengthened, especially in emerging economies such as Brazil, Chile, India, Mexico or South Africa. At the same time, those countries that are currently planning to create or strengthen their national databases need to be backed with training and technical assistance, such as Brazil, Chile, India, South Africa and Turkey.

Beyond the national level, efforts on the international level are now focusing increasingly on the question of database interoperatability. To this end the Global Network of Interoperable Databases is currently working on identifying a process that could lead to a better exchange of data between different databases. On a related issue, the work of the UNEP/SETAC Life Cycle Initiative's Flagship Project 2a on Data and Database Management will put a focus not only on training, but also on supporting the review of datasets in new databases to ensure the quality of the data that has been made available.

Taking all these elements together, we anticipate that, if the recommendations outlined in the previous chapters were to be put into an actual roadmap to further mainstream life cycle thinking around the world and given the overall market dynamics moving towards integrating sustainability into business practice, within the next five to ten years:

- Most of the key emerging economies will have reached at least the level at which the developed countries are now, and
- An important number of developing countries will have reached the level that a number of emerging economies have achieved nowadays.

Such a vision could be further developed and be used as an aspiration for the life cycle community.

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## About the Life Cycle Initiative

The Global Life Cycle Initiative was established by UNEP and SETAC. Among other things, the Life Cycle Initiative builds upon and provides support to the on-going work of UNEP on sustainable consumption and production, such as Industry Outreach, Industrial Pollution Management, Sustainable Consumption, Cleaner and Safer Production, Global Reporting Initiative (GRI), Global Compact, UN Consumer Guidelines, Tourism, Advertising, Eco-design and Product Service Systems.

The Initiative's efforts are complemented by SETAC's international infrastructure and its publishing efforts in support of the LCA community.

The Life Cycle Initiative is a response to the call from governments for a life cycle economy in the Malmö Declaration (2000). It contributes to the 10-year framework of programmes to promote sustainable consumption and production patterns, as requested at the World Summit on Sustainable Development (WSSD) in Johannesburg (2002).

The Life Cycle Initiative's vision is a world where life cycle approaches are mainstreamed and its mission is to enable the global use of credible life cycle knowledge for more sustainable societies.

Our current work is building on the Life Cycle Initiative's continual strength to maintain and enhance life cycle assessment and management methodologies and build capacity globally. As we look to the future, Life Cycle Assessment (LCA) and Life Cycle Management (LCM) knowledge is the Life Cycle Initiative's anchor, but we will advance activities on LCA and LCM to make a difference within the real world.

Therefore, the renewed objectives are the following:

Objective 1: Enhance the global consensus and relevance of existing and emerging life cycle methodologies and data management;

Objective 2: Expand capability worldwide to apply and to improve life cycle approaches; making them operational for organisations;

Objective 3: Communicate current life cycle knowledge and be the global voice of the Life Cycle community to influence and partner with stakeholders.

For more information,

**www.lifecycleinitiative.org**

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## About SETAC

The Society of Environmental Toxicology and Chemistry (SETAC) is a professional society in the form of a not-for-profit association, established to promote the use of a multidisciplinary approach to solving problems of the impact of chemicals and technology on the environment. Environmental problems often require a combination of expertise from chemistry, toxicology, and a range of other disciplines to develop effective solutions. SETAC provides a neutral meeting ground for scientists working in universities, governments, and industry who meet, as private persons not bound to defend positions, but simply to use the best science available.

Among other things, SETAC has taken a leading role in the development of Life Cycle Management (LCM) and Life Cycle Assessment (LCA).

The organization is often quoted as a reference on LCA matters.

For more information,

**www.setac.org**

## About the UNEP Division of Technology, Industry and Economics (DTIE)

Set up in 1975, three years after UNEP, the Division of Technology, Industry and Economics (DTIE) provides solutions to decision-makers and helps change the business environment by offering platforms for multi-stakeholder dialogue and cooperation, innovative policy options, pilot projects and creative market mechanisms to improve the quality of the environment and the well-being of citizens.

Within UNEP, DTIE has the mandate of delivering on environmental sustainability through technology, industry and economic policy by addressing environmental issues at global and regional levels, providing leadership and encouraging partnerships, and by informing and enabling nations and people to improve their quality of life without compromising that of future generations.

DTIE plays a leading role in three of UNEP's seven strategic priorities, namely in climate change, chemicals and waste, and resource efficiency.

The Office of the Director, located in Paris, coordinates activities through:

- The Chemicals and Waste Branch (Geneva, Paris and Osaka), which catalyses global actions to bring about the sound management of chemicals, the improvement of chemical safety and the management of waste.
- The International Environmental Technology Centre - IETC (Osaka) promotes the collection and dissemination of knowledge on Environmentally Sound Technologies with a focus on waste management. The broad objective is to enhance the understanding of converting waste into a resource and thus reduce impacts on human health and the environment (land, water and air).
- OzonAction (Paris) supports the phase-out of ozone depleting substances in developing countries and countries with economies in transition to ensure implementation of the Montreal Protocol.
- The Economy and Trade Branch (Geneva), which helps countries to integrate environmental considerations into economic and trade policies, and works with the finance sector to incorporate sustainable development policies. This branch is also charged with producing green economy reports.
- The Energy, Climate, and Technology Branch (Paris, Nairobi, and Copenhagen), which fosters energy and transport policies for sustainable development and encourages investment in renewable energy and energy efficiency.
- The Sustainable Lifestyles, Cities and Industry Branch (Paris), which delivers support to the shift to sustainable consumption and production patterns as a core contribution to sustainable development.

DTIE works with many partners (other UN agencies and programmes, international organizations, governments, non-governmental organizations, business, industry, the media and the public) to raise awareness, improve the transfer of knowledge and information, foster technological cooperation and implement international conventions and agreements.

For more information,

**www.unep.org/dtie**

***Based on an introduction setting the scene for life cycle approaches from an international perspective and a global survey answered in average by more than 10% of the more than 2,500 members of the mailing list of the UNEP/SETAC Life Cycle Initiative, this report describes the opportunities for national life cycle networks creation and expansion around the world.***

***A special focus is given on analysing the status of mainstreaming life cycle approaches, comprising especially also Life Cycle Assessment (LCA) database development, in G20 plus Switzerland and a few selected emerging economies.***

***The report concludes that mainstreaming is on-going and that having a life cycle network of certain maturity goes hand in hand with the development of a LCA database. A strong correlation is observed between having a national life cycle network with a legal entity and the probability of creating a LCA database; the survey also shows that a lot of countries have plans to develop a LCA database, while those who lack a networks also don't have plans to develop a LCA database. Using the results of the study, concrete recommendations are provided, including guiding principles for LCA network creation and next steps for LCA database development around the world.***

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