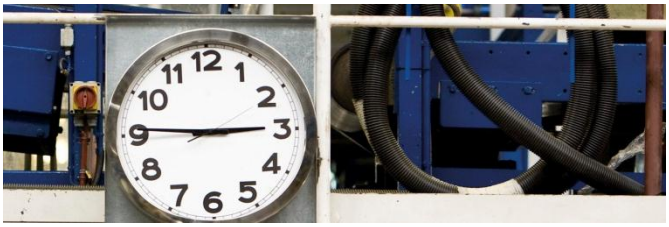
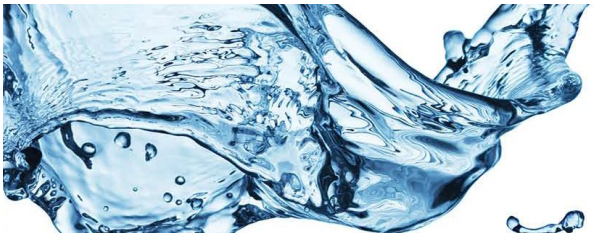
Accelerating Green Growth through Public-Private Partnerships

June 2012





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This report is based on the analytical work which McKinsey & Company has undertaken for the 3GF with input from the 3GF team and a number of experts.

In the development of this report, more than 70 individuals were interviewed, including industry experts, public sector representatives, and members of civil society. 3GF would like to thank all the governments, NGOs and companies who contributed to this research.

The opinions expressed and arguments employed herein do not necessarily reflect the official views of the 3GF partner organizations, corporations and governments.

3GF encourages interested parties to raise questions and objections about the appropriateness of the information presented in this document and welcomes comments.

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Introduction

A rapid, large-scale green transition is needed if global economic growth is to continue while simultaneously reducing greenhouse gas emissions, adapting societies to climate change and promoting a sustainable use of resources. This transition to a green economy has the potential to unlock new growth engines and spur business opportunities.

In 2011, the Danish Government together with the Governments of Korea and Mexico and a number of leading global corporations and international organizations launched a global public-private partnership for green growth, the Global Green Growth Forum (3GF).

The mission of the Forum is to explore and demonstrate how better collaboration among leading businesses, investors and key public institutions can effectively realize the potential for long-term global green growth.

3GF annually convenes a selected group of 200 political and business leaders to give momentum to long-term sustainable growth through scalable public-private partnerships (PPPs). The first Forum was held in Copenhagen on 11th-12th of October, 2011. The second Forum – 3GF2012 – will be held in Denmark on 9th-10th of October, 2012 under the thematic headline "Resource Efficiency and Growth". During 3GF2012, a number of concrete PPPs will be taken forward in key areas with potential resource efficiency gains.

This report presents an analytical framework for assessing potential partnerships to address resource productivity opportunities and then uses this framework to assess six selected opportunities.

The analytical framework is developed as a tool for 3GF to identify and focus on PPPs with a scalable, transformative growth potential. The paper is not intended as a roadmap for the development of concrete new PPPs, rather 3GF welcomes, and is potentially interested in taking forward, the development of PPPs inspired by the productivity opportunities outlined in this report, but shaped by the knowledge and experience of the public and private partners in the field.

The six opportunities were selected based on (a) their transformative potential for catalyzing green growth; (b) the existence of significant barriers preventing the capture of the opportunity; (c) an assessment of whether a PPP is the right form of intervention to address those barriers; and (d) the wide applicability of the opportunities to 3GF members and participants:

- *Food waste:* The reduction of both food losses in the food value chain and food waste at the consumer level.
- *Industrial energy efficiency in motor systems:* The introduction of energy saving measures in motor systems, such as adjustable speed drives, more energy efficient motors, and mechanical system optimization.
- *Urban water leakage:* The reduction of urban water leakage through better leak detection and repair in water distribution networks, households, and commercial and public premises.
- *Grid integration:* Investment in grid infrastructure to link renewables to the grid, better links between international markets, and connect key markets within countries.

- *Industrial wastewater reuse:* The reuse of wastewater within a single industrial plant or the sharing of waste water between partners such as two industrial plants or a municipality and an industrial plant.
- *Advanced bio-based fuels and chemicals:* The use of biomass residues or dedicated non-edible crops for the production of bio-based products such as biofuels, biochemicals and biomaterials.

These opportunities do not represent the full set of areas where PPPs could accelerate change. Other opportunities, such as improving the energy efficiency of buildings or developing new transport technologies such as fuel cells, may be further explored.

It is important to note that while public-private partnerships provide a useful tool to help unlock key opportunities, they are not sufficient if used as the only tool. Among other actions, it will be important to price resources to reflect their real cost to society such as removing water and energy subsidies.

Executive summary

It is important to develop a strong methodological approach to assess the potential of public-private partnerships (PPPs) to accelerate the transition towards a green economy. This approach is intended to inform the creation and design of new PPPs and also to assess gaps amongst existing PPPs.

A PPP can broadly be defined as any initiative which is funded and operated through an alliance between public institutions and private actors. Public-private partnerships are often used to fund infrastructure projects and have been growing in popularity. Public-private partnerships have also been formed to address societal challenges such as public health and economic development. For 3GF, a relevant PPP is defined as *a coordination mechanism between the activities of public and private actors that enables an accelerated transition to a green economy, with a particular focus on achieving speed to scale across borders.*

Based on expert interviews and a review of existing PPPs, we defined five key questions to assess whether a PPP can enable the transition to a green economy:

1. *Is the opportunity suitable for a PPP?* This involves understanding (a) whether the opportunity has transformative potential to accelerate resource productivity and create new green markets; (b) whether there are significant barriers (market and policy failures) preventing the capture of the opportunity; and (c) whether a PPP is the right form of intervention to address those barriers.
2. *What should be the PPP's scope and design?* This involves understanding which of the barriers preventing the capture of the opportunity are binding, and to what extent there is regional variation in those barriers, either in terms of their importance or in their nature. This understanding informs the design of the PPP and its geographical area of focus.
3. *Who should be involved in the PPP?* This involves understanding the critical stakeholders (e.g., companies, NGOs, governments, etc) who need to be included for the PPP to work. This also involves a review of existing PPPs to understand the degree to which they already fulfil these requirements and where further action may be required.
4. *How will this PPP achieve meaningful global scale?* This involves understanding the appropriate channels for scaling the PPP's impact across national boundaries, ranging from providing demonstration effects to influencing global value chains.
5. *How can the PPP be designed to maximize green growth?* Within the relevant channels for scaling the PPP's impact, it is important to ensure the PPP is designed to maximize economic growth and avoid potential hindrances to growth. It is also important that the PPP is designed to take an integrated approach to resources, minimizing trade-offs and maximizing co-benefits with other resources.

These questions are used to assess how public-private partnerships could help accelerate the transition to a green economy in six opportunity areas: food waste, industrial motor systems, urban water leakage, grid integration, industrial wastewater reuse, and advanced bio-based fuels and chemicals (Exhibit 1).

Exhibit 1

Applying the PPP framework to the six opportunities

	Key barriers	PPP archetype	Key actors	Scaling device
Food waste (high-income)	▪ Information failures ▪ Entrenched behaviour ▪ Regulatory support	▪ Coordination and delivery	▪ Food industry players, government, logistics providers	▪ Demonstration effect
Food waste (middle/low-income)	▪ Information failures ▪ Capital intensity ▪ Supply chain bottlenecks	▪ Coordination and delivery	▪ Food industry players, transport and storage providers, government	▪ Demonstration effect ▪ Influence value chain
Motor systems	▪ Information failures	▪ Awareness raising	▪ Gov't, motor manuf., manufacturing industry representatives	▪ Shape standards
Municipal water leakage	▪ Information failures ▪ Political feasibility ▪ Capital intensity	▪ Policy and regulation	▪ Municipal water utilities, equipment manuf., multilateral institutions	▪ Demonstration effect
Grid integration	▪ Regulatory support ▪ Political feasibility	▪ Policy and regulation	▪ TSOs, NGOs, regulators, utilities, and equipment suppliers	▪ Penetrate new markets ▪ Open-source key materials
Industrial waste water	▪ Information failures	▪ Awareness raising	▪ Wastewater utilities, water-intensive industry players, regulators	▪ Open-source key materials
Advanced bio-based fuels and chemicals	▪ Technological read. ▪ Network effects ▪ Capital intensity	▪ Product development	▪ Government, biofuel producers, academics	▪ Create tipping point

SOURCE: Team analysis

These six opportunities were selected based on: their transformative potential for catalyzing green growth; the existence of significant barriers preventing the capture of the opportunity; whether a PPP is the right form of intervention to address those barriers; and the wide applicability of the opportunities to 3GF members.

The analysis of the six resource productivity opportunities supported by McKinsey & Company seems to have the potential to access resource savings worth up to $840 billion per year in 2030 or over 22 per cent of the total identified global resource productivity benefits. It is important to stress that the sizing of these benefits represents the entire global opportunity, not the portion which a PPP could address which is a fraction of this figure. In addition, capturing this opportunity will not be straightforward – there are a range of different barriers that stand in the way, and realistically only a share of the potential savings is likely to be realized.

Capturing some of these opportunities will require overcoming a variety of barriers, which vary by region and by opportunity:

- Reducing food waste in high income countries requires addressing information failures and entrenched behaviours, as well as introducing new forms of regulatory support. For example, in the European Union, "Good Samaritan" laws—akin to those in the United States which clear grocers of liability for foodstuffs that they donate to charity— could clarify the liabilities surrounding food donation.
- Motor system efficiency is constrained by (i) information failures resulting from a lack of standards classifying the energy efficiency of motor systems, and (ii) agency issues in which managers lack incentives to improve the life-cycle costs of the motors they buy.
- In urban water leakage, the major barriers to change are political feasibility related to adopting appropriate pricing mechanisms for water and dealing with disruptions from water main repairs, information failures and capital requirements.

- In waste water, the major barriers relate to low business awareness of opportunities for alternative sourcing of water for industrial processes and low awareness about the true cost of water used in industrial processes.
- In grid integration, the major barriers seem to include political feasibility in the form of lengthy and ineffective permitting procedures; a lack of regulatory support for justifying new cross-border transmission projects based on socioeconomic welfare criteria; and agency issues from cross-border inter-connectors because they often result in an asymmetrical distribution of benefits.
- Finally, with advanced bio-based fuels and chemicals, the major barriers are related to technological immaturity, combined with a lack of standardised methodologies to assess their full environmental impact.

Based on an analysis of these barriers and the existing landscape of initiatives including existing public private partnerships, some examples of opportunities for PPPs are presented below. These are only examples based on the analysis, and there would, naturally, be other PPPs which would likewise have the potential to capture parts of the resource opportunities:

- ***Food waste (high-income countries):*** *Development of a reverse supply chain to divert food waste to its most efficient possible end use.* Existing PPPs such as FUSIONS play an important role targeting the prevention of food waste—and can be supported in these efforts—but a new PPP could also potentially play a role redirecting waste to more efficient end uses. As part of such a PPP which will need to be tailored to each specific local context, an at-scale logistics system to collect food waste from farms, wholesalers, and retailers could be developed. In similar models, logistics companies (e.g. from the waste management industry) have provided free collection on the condition that they can sell or process what they collect. From a centralised collection hub, products could either be returned to the retail market, for near-term sale, or can be linked to auction/claiming systems for food banks, composting firms, or livestock breeders. Meanwhile, centralised logistics could enable collection of granular data on food waste. If needed, anonymity could be guaranteed to donors. Regulatory agencies may also need to clarify liabilities in instances of donation, or rationalise laws surrounding animal feed, e.g. “Good Samaritan Laws”.
- ***Food waste (middle- and low-income economies):*** *Address supply chain bottlenecks by supporting coordinated investments in supply chain development and by improving data collection.* In middle and low income countries, governments and supporting multilateral institutions such as the International Finance Corporation (IFC) and the World Bank could facilitate supply chain coordination which would enable food and beverage companies to provide joint investment in supply chain improvements at a scale that often is not feasible or attractive for any single player.
- ***Industrial energy efficiency (motor systems):*** *Establish standards for motor systems similar to those that exist for individual motors.* A potential opportunity exists for a PPP focused on motor system efficiency, by driving toward the coordinated global adoption of motor system standards. A coalition of industry leaders in a range of countries could, for instance, push for the establishment of voluntary standards for common archetypes of motor systems. The development of this voluntary set of norms might in turn accelerate the adoption of a more formal set of global industry standards.
- ***Urban water leakage:*** *A multi-local, city-focused approach to addressing water leakage.* This could involve leveraging a network of cities like the existing C40 platform to make water supply efficiency a goal for member cities. The PPP could help facilitate a wide range of actions. Fundamentally, the PPP would be looking to lower risk for all parties –

for the municipality in raising water rates and disrupting roads etc, and for the companies in terms of investing in new infrastructure. One or a handful of major cities with high leakage rates could be selected as pilot model cities for major urban water supply improvement projects. A group of lead "best practice" cities with experience in leakage reduction and supply improvement. The projects would hinge on the commitment and leadership of the municipal water utility of the pilot city in question. This could also be supported by development of more detailed data on water leakage, including "global league tables" and consumer data applications that can help spur action.

- ***Grid integration:*** Grid integration may be accelerated, mostly on regional and national levels, through a PPP to disseminate grid integration best practices around addressing issues such as public acceptance, permit process streamlining, regulatory frameworks, cost recovery mechanisms and access to finance. It is, however, important to recognise that the nature of barriers will vary in each local context and hence the approach to supporting grid integration will need to be appropriately tailored.

- ***Industrial wastewater reuse:*** *Matching plants producing waste water with those that could use it.* WaterMatch, a free website and data portal that attempts to facilitate matches between producers and potential users of industrial wastewater, or another platform with a similar approach, could potentially be scaled up in a three step approach. First, regulators could work with local wastewater treatment plants to provide up-to-date data on wastewater availability and facilitate the matchmaking process in lead countries (chosen based on level of water scarcity, current reuse levels, and the presence of water-intensive industrial activity). Second, the database could partner with water-intensive industries to populate the site with data of their treated effluent volumes and the related quality. Finally, a water analytics toolkit that would help water-intensive industries understand the true cost of water in their internal processes, and then determine whether and how they could re-use some of their own effluent streams. This PPP can achieve global scale by providing a cross-country database of wastewater.

- **Advanced bio-based fuels and chemicals:** There may be an opportunity for a PPP to help bio-based-products - such as ligno-cellulosic processes (transformation of ligno-cellulosic feedstock into biofuels or bio-chemicals), biogas (methane), biodiesel from animal fat, methanol based on biomass etc., to become commercially viable. Different nations and regions would have different motivations for supporting a PPP promoting advanced bio-based fuels and chemicals, ranging from energy independence, GHG mitigation, job creation or development of a competitive high technology industry. The PPP could cover different combinations of feedstock, processes and end-products (fuels or chemicals) depending on the objectives of the nations/regions supporting it and the nature of the feedstock available locally. It could be an objective to establish clear and pragmatic standards around environmental footprint accounting that would provide further stability to prospective investors in this field.

Successful action on PPPs like these could potentially deliver a significant share of the available resource benefits. Across each of these opportunity areas, there are a set of implications for cities, public procurement, international trade, and finance. Some of the PPP opportunities discussed here could be integrated into existing structures or existing PPPs, while others would require more of a push to develop new partnerships.

A framework for assessing potential PPPs to accelerate green growth

A PPP can broadly be defined as an alliance between public institutions and private actors designed to address a common purpose as well as satisfy the interests and needs of its members, participants and stakeholders. Public-private partnerships are often used to fund infrastructure projects and have been growing in popularity on the back of increasing regulation that allows for them in regions such as California and more recently Mexico.[1] Public-private partnerships have also been formed to address societal challenges such as public health and economic development. The effectiveness of PPPs, however, varies widely. Analysis of past PPPs suggests that they are successful when there is a sufficient alignment of interests between the private and public actors and the partnership to allow the group to overcome barriers that they would have been unable to conquer alone

For 3GF, the PPPs that are relevant are defined as *a coordination mechanism between the activities of public and private actors that enable an accelerated transition to an inclusive green economy, with a particular focus on achieving speed-to-scale across borders.* This definition has several critical elements:

- As a **coordination mechanism**, a PPP serves as a forum or medium to coordinate ongoing activities between multiple parties to overcome market failures which no single actor could deal with alone.
- Through this mechanism, **public and private sector actors**, which are loosely defined as governments and international organizations on the public side and businesses and civil society on the private side, work together towards a common goal.
- This common goal is to **accelerate the transition to a green economy**, in part by increasing the growth rate of markets for new products which have an advantage due to their higher natural resource efficiency or lower negative environmental externalities, but which may be constrained by factors such as transaction costs, lack of externality pricing and/or immaturity of the new, greener technologies.
- The objective of this acceleration is to achieve **speed-to-critical scale in the transition to an inclusive green economy, which usually requires international impact, such that the relevant new market(s)** reach the inflection point of a classic adoption s-curve, implying continued market growth into the future without substantial additional intervention.

Public-private partnerships can play a leading role in shaping tomorrow's markets, effectively overcoming policy and market weaknesses and failures by catalysing policies, creating standards, strengthening price signals, mobilizing and directing capital, and supporting technology development.

It is important to have a robust methodology for understanding the potential for public-private partnerships to accelerate a transition towards a green economy, with a particular focus on speed to scale across international borders. This approach can then be used to (a) identify areas where a PPP would make sense (and not make sense); (b) ensure that a new

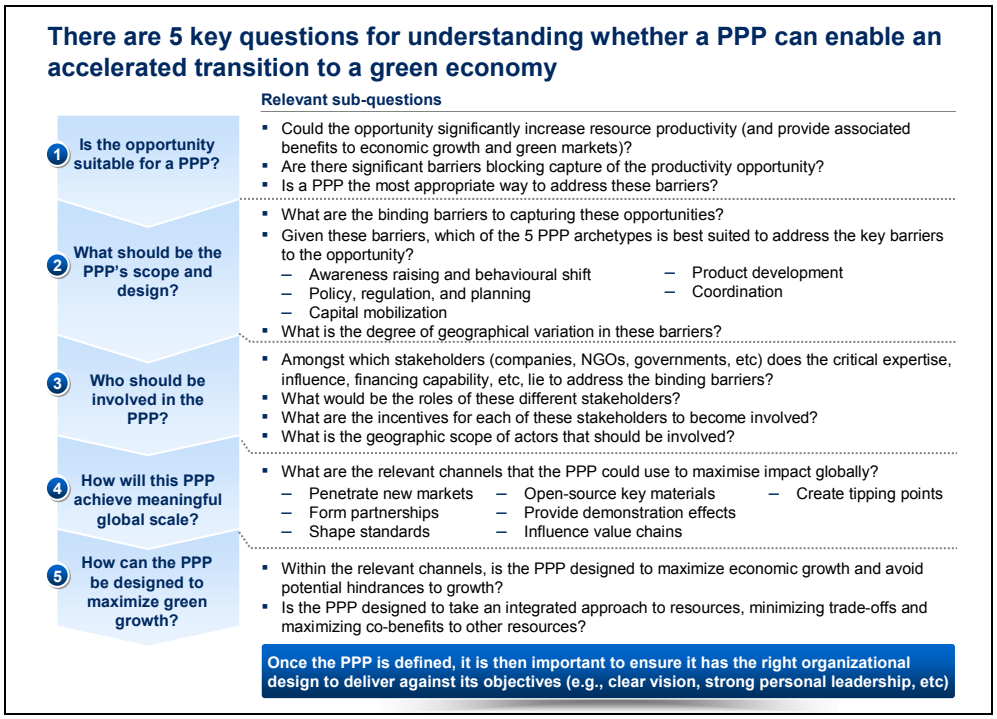
[1] In 2009 legislation was enacted in California which gave local governments greater freedom to get involved in PPPs. On January 16th, 2012, Mexico enacted the *Ley de Asociaciones Publico Privadas* which allows greater cooperation between government agencies and private actors over the construction of infrastructure projects and the provision of related services. For more information see: Sherman & Sterling, LLP, *Mexico enacts PPP law,* 2012.

PPP is designed appropriately to capture the opportunity; and (c) evaluate existing PPPs and understand where there may be gaps that need to be addressed. To our knowledge, this is the first time that a methodological bridge has been built between green growth and public-private partnerships.

Such a robust approach needs to be conscious of what it takes to overcome barriers, who needs to be at the table, and how best to avoid unintended and unwanted consequences. There is no need to overly conceptual or complex, rather, the need is to be strategic and systematic. A simple, useful framework has been developed through a review of existing successful (and failed) PPPs, a series of expert interviews and the insights gained from leaders and participants of the PPPs that are currently being profiled and supported through the 3GF. The framework is still a work in progress, with the expectation that the approach will be refined with further input from 3GF members and other key experts and stakeholders.

There are five key questions for understanding whether a PPP can enable an accelerated transition towards green markets of a critical scale (Exhibit 2):

Exhibit 2



1. *Is the opportunity suitable for a PPP?* This involves understanding (a) whether the opportunity has transformative potential to significantly accelerate resource productivity and create new green markets; (b) whether there are significant barriers (market and policy failures) preventing the capture of the opportunity; and (c) whether a PPP is the right form of intervention to address those barriers.
2. *What should be the PPP's scope and design?* This involves understanding which of the barriers preventing the capture of the opportunity are truly binding in order to help focus the PPP's efforts. The appropriate archetype of PPP can then be developed based on those barriers, including a consideration of the degree to which there is regional variation in those barriers (either in terms of their importance or in their nature), which can suggest the appropriate geographical area of focus.

3. *Who should be involved in the PPP?* This involves understanding the critical stakeholders (e.g., companies, NGOs, governments, etc) who will need to be included in the PPP if it is going to be successful and ensuring that there are incentives for them to participate. This also involves a review of existing PPPs to understand the degree to which they already fulfil these requirements and where there may be incremental action required.
4. *How will this PPP achieve meaningful global scale?* This involves understanding the appropriate channels for scaling the impact of the PPP across national boundaries, ranging from providing demonstration effects to influencing global value chains. The appropriate scaling mechanism will depend on the nature of the barriers and the degree of complexity involved in transferring knowledge and capabilities to other regions.
5. *How can the PPP be designed to maximize green growth?* Within the relevant channels for scaling the impact of the PPP, it is important to ensure the PPP is designed to maximize economic growth and avoid potential hindrances to growth. It is also important that the PPP is designed to take an integrated approach to resources, minimizing trade-offs and maximizing co-benefits with other resources.

We now discuss each of these questions in further detail.

1. Is the opportunity suitable for a PPP?

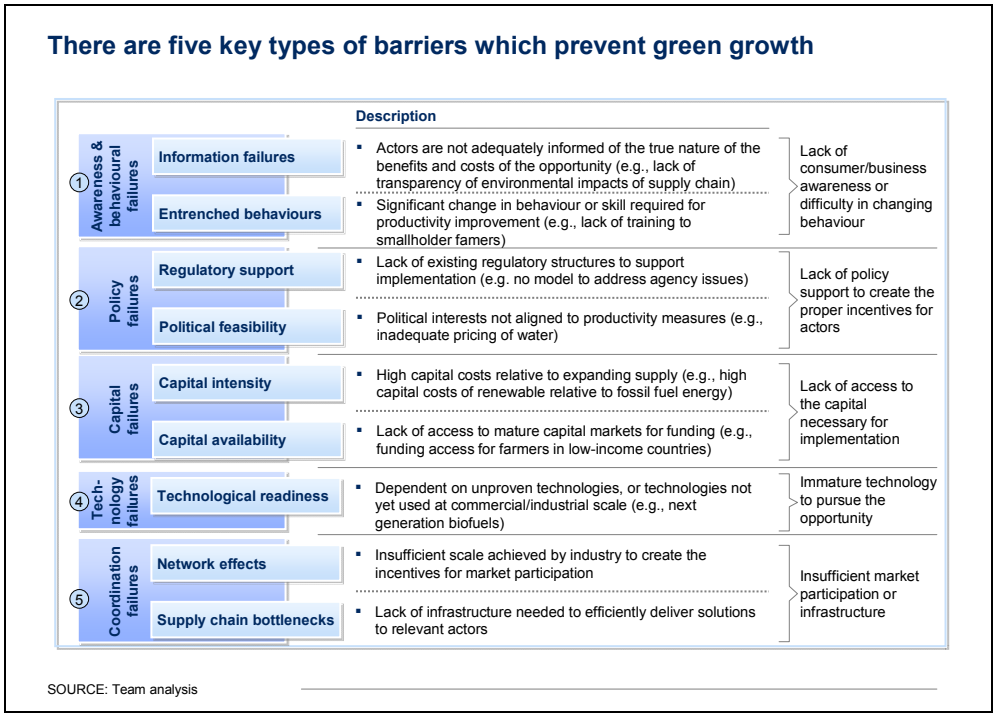
There are three important sub-questions to understand whether an opportunity is suitable for a PPP:

i. *Is there a significant opportunity to accelerate resource productivity (and associated economic growth and green markets)?* This involves assessing the global potential benefits for society associated with the resource productivity opportunity, understanding how this could be linked to economic growth (through the channels described later in this report), and understanding the potential to create new green market opportunities (and whether the potential returns could meet a relevant private sector hurdle rate). This draws upon global data sources[2], as well as expert interviews.

ii. *Are there significant barriers blocking the capture of the opportunity?* The obstacles include (a) *Awareness & behavioural failures* (where there is a lack of consumer or business awareness of the issue or difficulty in changing entrenched behaviours); (b) *Policy failures* (where there is a lack of regulatory frameworks to support change); (c) *Capital failures* (where there is a lack of access to the capital necessary for implementation); (d) *Technology failures* (where the technology to pursue the opportunity is still immature); and (e) *Coordination failures* (where there is insufficient market participation or infrastructure to support change). A summary of these barriers is presented below (Exhibit 3).

[2] For example, *Resource Revolution: Meeting the world's energy, materials, food, and water needs*, McKinsey Global Institute and McKinsey Sustainability and Resource Productivity practice, November 2011.

Exhibit 3



iii. *Is a PPP the most appropriate way to address these market failures?* This involves assessing whether the critical barriers require joint, coordinated action from public and private players. PPPs tend to be most suitable in pre-competitive industry situations or when price is not the only barrier to implementation. For example, there may be additional barriers beyond "getting prices right" that need to be overcome to accelerate change, including awareness and behavioural failures, policy failures, capital failures, technology failures, and coordination failures. In other cases, there may be a first mover disadvantage such that competitors are not incentivised to take action in the current rules of the market. PPPs could also be appropriate in situations where there is a need for the suspension of normal rules to spur action (e.g., relaxation of anti-trust regulations to encourage collaboration on standards formation). This analysis would also consider whether there are other ways to address the identified barriers that would not require a PPP, and whether the expected benefits of partnership outweigh the costs of the time and resources needed to run the partnership effectively.

2. What should be the PPP's scope and design?

Where a PPP is the best way to address an opportunity, it should be focused on overcoming the critical barriers preventing the capture of the opportunity, be able to avoid becoming too unwieldy and costly, and be able to avoid the risk of negative unintended consequences. Based on an assessment of the critical barriers (discussed in step 1), the appropriate archetype of PPP can be developed.

Prime candidates are often those that aim to establish new market rules, for example through certification schemes and product labelling. Initiatives such as Bonsucro (previously the Better Sugarcane Initiative) and the Forest and Marine Stewardship Council's exemplify such approaches, as do a growing number of commodity roundtables. Initiatives focused on mobilizing finance also open new market opportunities as well as establishing conditions

under which enterprises can enter markets. Health partnerships such as the Global Fund and the GAVI Alliance illustrate this type of partnership. Other initiatives are designed to engage business and public institutions in policy changes intended to create the enabling conditions for private and public investment, such as Desertec in Morocco, focused on renewable energy investment linked to supply access to the European grid. Then there are those partnerships intended to change the behaviour of market actors in order to influence the behaviour of government, such as the Extractive Industries Transparency Initiative and the Global Network Initiative. Even those partnerships with more limited aims to facilitate knowledge exchange, awareness raising and co-ordination can and do impact market behaviour, such as the ways in which the Clean Energy Ministerial and Global Green Growth Forum stimulates new relationships and associated actions involving businesses and governments. Finally, there are technology/R&D-driven PPPs such as platforms like ZEP (zero-emissions power) and ETI (for low-emissions technology) in the UK which aim to reduce the time required for new green technologies to reach cost competitiveness with existing alternatives.

Overall, this research has identified five core archetypes of PPPs (Exhibit 4): (i) Awareness raising and behavioural shift; (ii) Policy and regulation; (iii) Capital mobilization; (iv) Product development; and (v) Coordination and Delivery. In some cases, a PPP may require a hybrid structure, which draws on multiple archetypes.

Exhibit 4

There are 5 key archetypes of public-private partnership

The "binding" constraints or barriers can be used to identify the appropriate form of PPP design. In some cases, this may be a combination of different archetypes.

	Description	Geographic focus	Example PPPs
1 Awareness raising and behavioural shift	▪ Creates transparency to costs and benefits of different products to improve decision making power of actors ▪ Provides training or mindset shift required to support behavioural change	▪ Cross-border	▪ Roundtable on Sustainable Palm Oil (RSPO) ▪ Forest Stewardship Council (FSC)
2 Policy and regulation	▪ Changes market structures through regulatory reform or development of new instruments ▪ A commitment device to build the political will needed to address a challenge	▪ Multi-local (primary) ▪ Cross-border (e.g., international trade)	▪ Water Resources Group (WRG)
3 Capital mobilization	▪ Supports the mobilization of private capital by reducing associated risks such as currency risk, country risk and policy risk, and by overcoming start-up challenges (e.g., providing loan guarantees to local banks to spur lending)	▪ Cross-border	▪ GAVI Alliance
4 Product development	▪ Promotes early-stage product development by enabling critical research and development activities, and supporting project developers and trial projects	▪ Cross-border	▪ Global Carbon Capture and Storage Institute (GCCSI)
5 Coord-ination and delivery	▪ Brings together actors from relevant industries to accelerate overcoming initial network effects ▪ Combines logistical capabilities, infrastructure, local networks, and project management expertise that no single organization possesses alone	▪ Multi-local	▪ "Moving the World" programme (TNT / WFP) ▪ WBCSD Urban Infrastructure Initiative (UII)

SOURCE: Team analysis

3. Who should be involved in the PPP?

This involves understanding the critical stakeholders (e.g., companies, NGOs, governments, etc) who will be need to be included in the PPP if it is going to be successful. This should be based on understanding the critical barriers preventing the capture of the opportunity and what will be required to overcome them. The relevance of including certain stakeholders could be for different reasons, such as their expertise, influence on key decision makers, financing capability, etc. Once the stakeholders are identified, it is then critical to understand what are the incentives for each of them to participate – for example, are there

potential returns available that will exceed the relevant hurdle rate of the private sector companies; is the issue aligned with the key concerns of relevant NGOs; can the PPP help achieve government policy objectives and thereby warrant government involvement?

It is then important to review existing PPPs operating in this space to understand the degree to which they already fulfil the key design and participation requirements highlighted above. This can then be used to inform a decision on whether there is no incremental change required, whether there may be a partnership opportunity, or whether a new PPP is required.

4. How will this PPP achieve meaningful global scale?

This involves understanding the appropriate channels for scaling the impact of the PPP across national boundaries. Our research has identified seven key channels for scaling the impact of the PPP (Exhibit 5). The appropriate scaling mechanism will depend on the nature of the barriers and the degree of complexity involved in transferring knowledge/capabilities to other regions. For example, when the key barrier is related to information failures and there is relative consistency in the type of information failure concerns across regions (e.g., lack of awareness of the scale of the municipal water leakage problem), then a scaling approach of "open-sourcing" key materials that enables institutions in other regions to mimic impact may be most appropriate. Alternatively, if technological readiness is the key barrier, then focusing on achieving critical scale to enhance learning curve effects may be most appropriate (e.g., advanced bio-based products).

Exhibit 5

There are seven ways through which a PPP can create scale

Type	Description	Situations when most relevant
Penetrate new markets	▪ Expand operations of existing partnership to cover new regions	▪ Similar barriers across regions provides opportunities to expand; high "learning by doing" effects
Form partnerships	▪ Join forces with other institutions or bring new players into the partnership through building alliances	▪ Barriers require additional stakeholders to help address the challenge
Shape standards	▪ Spur international institutions to adjust trade requirements or international standards, compelling change more broadly	▪ Agency issues and information failures are the primary barriers
Open-source key materials	▪ Publicly provide knowledge-base aimed at enabling other institutions in other regions to mimic impact	▪ Information failures primary barrier consistently across regions; relatively low complexity in implementation
Provide demonstration or "lighthouse" effect	▪ Demonstrate potential of new approach, inspiring others to mimic	▪ Information failures primary barrier consistently across regions; medium complexity in implementation
Influence value chain	▪ Spur local efforts that compel broader regional or global industries to adjust value chain	▪ Large share of opportunity concentrated in a few supply chains of key players
Create tipping point	▪ Drive scale and cost competitiveness more broadly through local investments	▪ Technological readiness is primary barrier

SOURCE: Team analysis

How public-private partnerships impact on markets often changes over time, involving a subtle interplay between early-stage voluntary action, and at times policy and regulatory

developments resulting from the partnership's impact through voluntary adoption and policy advocacy. The Forest Stewardship Council's engagement in China, for example, has been successful not only in securing the participation of a growing number of Chinese forestry and wood product companies, but in encouraging the Chinese Government's Forestry Department to adopt a set of sustainable forestry guidelines. The Global Reporting Initiative, designed to increase companies` public reporting of sustainable impacts, has positively impacted the willingness of governments and major stock exchanges to build non-financial reporting into corporate governance regulations and risk-based reporting requirements associated with public listings, and has directly catalysed the creation of the International Integrated Reporting Committee, which is creating a new generation of statutory corporate reporting standards that will combine financial and non-financial performance measures. Similarly for many labour and commodity-focused public-private partnerships, where maturing success has combined a scaling-up of take up with a growing engagement of policy and regulatory tools driven by governments and other public institutions.

That said, some public-private partnerships may also achieve scale simply through ever-greater adoption, the approach being taken by the Marine Stewardship Council, whose certification now covers 10% of the world's wild fish catch. Beyond certification and standards, partnership approaches might equally be just one of the steps needed to reach scale. Health partnerships such as the Global Fund, for example, clearly aspire to support the development of effective and sustainable national health infrastructure and financing, just as knowledge partnerships such as the recently established Green Growth Knowledge Platform might well have a limited lifespan until such time that relevant knowledge is autonomously generated, shared and applied by the mainstream research and policy community.

5. How can the PPP be designed to maximize growth?

Public-private partnerships can and do impact markets in ways that only benefit some parts of the business community. In part this is a deliberate and visible part of the design. Companies participating for example in the Roundtable on Sustainable Palm Oil are intended to benefit through enhanced reputation and interest on the part of increasingly aware consumers, just as businesses and governments partnering through the Extractive Industry Transparency Initiative are likely to access more easily or on better terms development and even commercial finance. Differential impacts are not, however, always deliberate or visible. Smaller and new business entrants, often supported by their home governments, complain that public-private partnerships unintentionally or otherwise restrict their market access, and unduly benefit larger incumbent businesses. This concern is all the greater where the partnership's means of impacting market behaviour is to establish sophisticated and costly standards that are more easily met by mature companies selling higher-margin, premium-branded products and services.

Differential impacts, therefore, are both intended to move markets towards more sustainable practices, and can include unintentional or otherwise unacceptable restrictions that must be avoided through design or mitigated subsequently (Exhibit 6). The spread of participants and funders has a major impact on the design of a public-private partnership, and so also its intentional and less visible discriminatory impacts. One strength of the UN Global Compact, for example, is the fact that over half of its signatory business participants are from outside of the OECD. Similarly for the UN`s International Labour Organisation, which is in fact a highly-structured, institutionalised public-private partnership. Bonsucro, like a growing number of partnerships, has diversified its membership from its original

weight of European and North American companies to include companies from North Africa, and Latin and Central America. Other partnerships remain dominated, however, by incumbent businesses, especially from Europe and North America, which may well over time limit their success in going to scale, or indeed challenge their very survival. Enabling platforms such as the Global Green Growth Forum are increasingly focused on ensuring a more balanced participation of enterprises and governments in public-private partnerships focused on scaling green growth opportunities.

Exhibit 6

PPPs need to be designed carefully to avoid adverse consequences to economic growth and resource efficiency

	Description	Measures to avoid risk	Example measures
Rebound effects	▪ Resource efficiency measures lead to a spike in demand that offsets savings	▪ Include behaviour measures to change attitudes and actions of participants	▪ Denmark maintained oil price at consistently high-level through taxation, with proceeds used to lower labour taxes
Trade barriers	▪ Countries ban or otherwise punish imports in their efforts to promote resource efficiency	▪ Include broader sets of participants including both large and small organisations as well as broad international groups	▪ UN Global Compact has half of its signatories from outside of the OECD ▪ Bonsucro (Better Sugarcane Initiative) has members from Europe, North America, Africa, Latin America, and Central America
Inefficiently deployed capital	▪ A drive for resource efficiency leads to investment in projects that deploy capital less efficiently than other potential projects	▪ Create transparency to capital investment projects	▪ Use of reverse auctions to create more transparency in feed-tariffs

SOURCE: McKinsey Global Institute, OECD, Berkeley Roundtable, European Commission, Moody and Nogrady, von Weizsacker, Oxford University

It is also important that the PPP is designed to take an integrated approach to resource mobilization, minimizing trade-offs and maximizing co-benefits with both immediate participants and other key stakeholders. For example, more energy-efficient pumps can place additional stress on water aquifers if the energy cost reduction leads to a rebound effect on water use and so may require action to mitigate these effects.

Realising the potential of public-private partnerships to support speed-to-scale green growth requires a designed alignment between the opportunities and partnership design, together of course with effective implementation. This in turn requires careful consideration in particular to be given to the type of partnership required, with at least some analysis of how the partnership's manner of impacting might evolve over time. Alongside this is the critical issue of participants, where impact in practice will have much to do with success in assembling both the right types of participants (e.g. public, private) and the needed geographic and sectoral distribution as a function of the scope and dynamics of the markets targeted. Only then can attention usefully be placed on the second level of operational design, including governance, financing and so on.

Overview of main findings on the six resource productivity opportunities

This section of the report provides an overview of the opportunity to accelerate the transition to a green economy through public-private partnerships in six resource productivity areas: food waste, motor system efficiency, urban water leakage, industrial waste water, grid integration and advanced bio-based fuels and chemicals. These six opportunities were selected based on the criteria outlined in the previous section as well as the wide applicability of the opportunities to 3GF members. These opportunities do not represent the full set of areas where PPPs could accelerate change. A more detailed assessment of each opportunity against the criteria described in the previous section of the report is provided in the appendix.

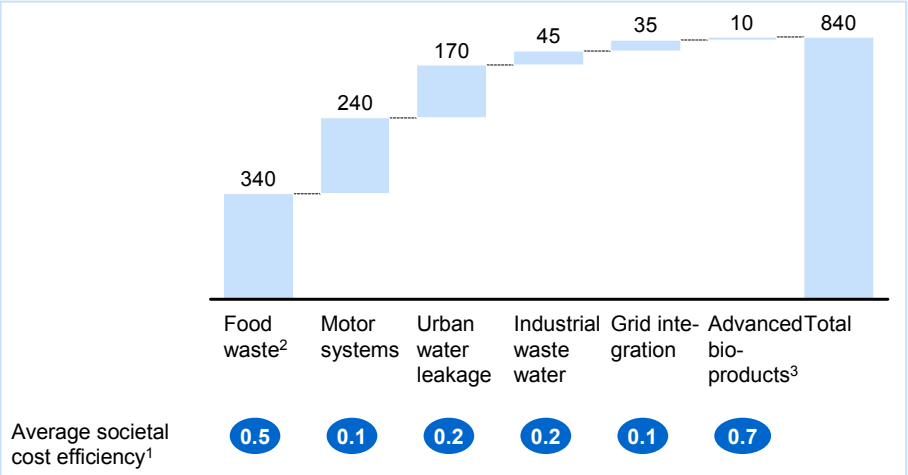
Accelerating green growth in 6 areas could contribute to the capture of up to $840 billion in resource savings per year in 2030

The analysis of the six resource productivity opportunities supported by McKinsey and Company in this report seem to have the potential to access resource savings worth up to $840 billion per year in 2030 or over 22 per cent of the total potential global resource productivity benefits identified in the report 'Resource Revolution: meeting the world's energy, materials, food, and water needs' by McKinsey and Company (Exhibit 7).[3]

Exhibit 7

Globally, the six productivity areas could provide potential annual resource savings worth up to $840 billion annually in 2030

Annual resource benefits, societal perspective, $ billion, 2030



1 Annualised cost of implementation divided by annual total resource benefit. Any number less than 1 implies the benefits exceed the related costs.
2 Average societal cost efficiency excludes costs only accounts for supply chain food waste and excludes the costs and benefits of consumer food waste
3 Includes carbon benefits from next generation biofuels plus potential savings in gasoline prices through ethanol purchases

SOURCE: McKinsey "Resource Revolution" report; Various data sources (see appendix); McKinsey analysis

[3] Resource Revolution: Meeting the world's energy, materials, food, and water needs, McKinsey Global Institute and McKinsey Sustainability and Resource Productivity practice, November 2011. The $3.7 trillion of resource savings estimated in this report does not include potential resource savings from grid integration or bioproducts.

It is important to stress that capturing this opportunity will not be straightforward – there are a range of different barriers that stand in the way. In addition, the identified PPPs will realistically only capture a portion of this potential opportunity. Below we discuss each of the opportunities in further depth.

- **Food waste.** Food waste represents the biggest opportunity for resource productivity of the six opportunities analyzed here with savings worth up to $340 billion globally, per year, by 2030. This opportunity spans both high-income economies where supply chains are more efficient to middle- and low-income economies with less advanced supply chains. In fruits and vegetables, for example, roughly 50 per cent of all produce grown is wasted in the EU, the US, and in Sub-Saharan Africa.[4] However, in high-income economies a majority of the waste is either at the farm—where products are discarded because they do not meet quality specifications or because of over production—or by the end user. In middle- and low-income economies on the other hand, inadequate supply chain infrastructure means that waste is concentrated from post harvest to distribution. Reducing food waste would be very capital intensive in middle- and low-income countries where the supply chain infrastructure is not in place.

- **Motor system efficiency.** Improving motor system efficiency could yield up to $240 billion in annual resource savings by 2030 globally, see appendix A3. Industrial motor systems represent roughly 45 per cent of global electricity consumption, and 70 per cent of manufacturing sector consumption. Motor system efficiency represents one of the largest opportunities in energy efficiency within the industrial sector. At the same time, motor systems seem to be an under-explored opportunity in terms of optimizing efficiency. While improving the efficiency of motors themselves can reduce the electricity consumption of a given plant by 2–5 per cent, improving the efficiency of the systems in which motors are embedded can yield reductions of up to 20–30 per cent.[5]

- **Urban water leakage.** Globally, reducing urban water leakage could provide up to $170 billion in resource benefits by 2030. In many countries, more than a third of urban water is wasted—and in some countries that figure is higher. In Turkey, for instance, 59 per cent of the water supply is wasted. In terms of volume savings, improved irrigation practices have the highest benefit. However, as municipal water is valued at about 15 times as much as bulk water used in agriculture—due to requirements in treating water to ensure safer consumption—the value saved by reducing urban leakage is significantly higher.

- **Waste water reuse.** Global Water Intelligence suggests that the world needs to reuse half its water supply if it is to meet its water challenges over the next two decades.[6] Current reuse rates in most countries fall well below this target—14 per cent of water is re-used in the United States and China, 11 per cent in Spain, and only 4 per cent in Mexico.[7] Past McKinsey analysis of the issue shows that increasing the reuse of wastewater could lead to up to $45 billion in annual resource savings by 2030.

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[4] FAO: "Global Food Losses and Food Waste: Extent, Causes and Prevention", 2011

[5] UNIDO: "Motor Systems Efficiency Supply Curves", December 2010

[6] "Global Water Market 2011", Global Water Intelligence, 2011.

[7] Ibid.

- **Grid integration.** Optimising transmission infrastructure to support the integration of renewable energy sources presents a significant economic opportunity. In Europe, a roughly $1.5 billion annualized investment in transmission expansion could lead to electricity savings of roughly $11 billion annually by 2030 and carbon savings of $1 billion, for net savings of over $10 billion per year.[8] These savings come primarily from electricity production costs due to lower requirements for relatively carbon-intensive back up capacity throughout the system. Assuming the European opportunity can be extrapolated worldwide, it translates into a roughly $35 billion global annual opportunity in 2030. The savings estimates for grid integration are based on estimates for Europe in 2030 (from the "Power Perspectives 2030," European Climate Foundation, 2011), adjusted for Europe's estimated share of the world's energy production in 2030 (12%), as well as the proportion of the world's production occurring in countries greater than 25% renewable penetration in capacity terms (36%), as this is where the grid integration opportunity is likely to be greatest. For further details, please see the appendix.

- **Advanced bio-based fuels and chemicals.** The savings opportunity from a substantial shift away from fossil-based fuels and chemicals towards bio-based-products is hard to quantify because key technologies such as ligno-cellulosic (LC) are still at an early stage of moving into industrial scale application with falling costs. The estimate shown here is, conservatively based on 60 billion gallons of biofuel supply with direct carbon benefits of 30 $ per tonne. The development of a cost-effective advanced bio-products market would also lay the foundations for advanced bio-based fuels and chemicals, providing further benefits.

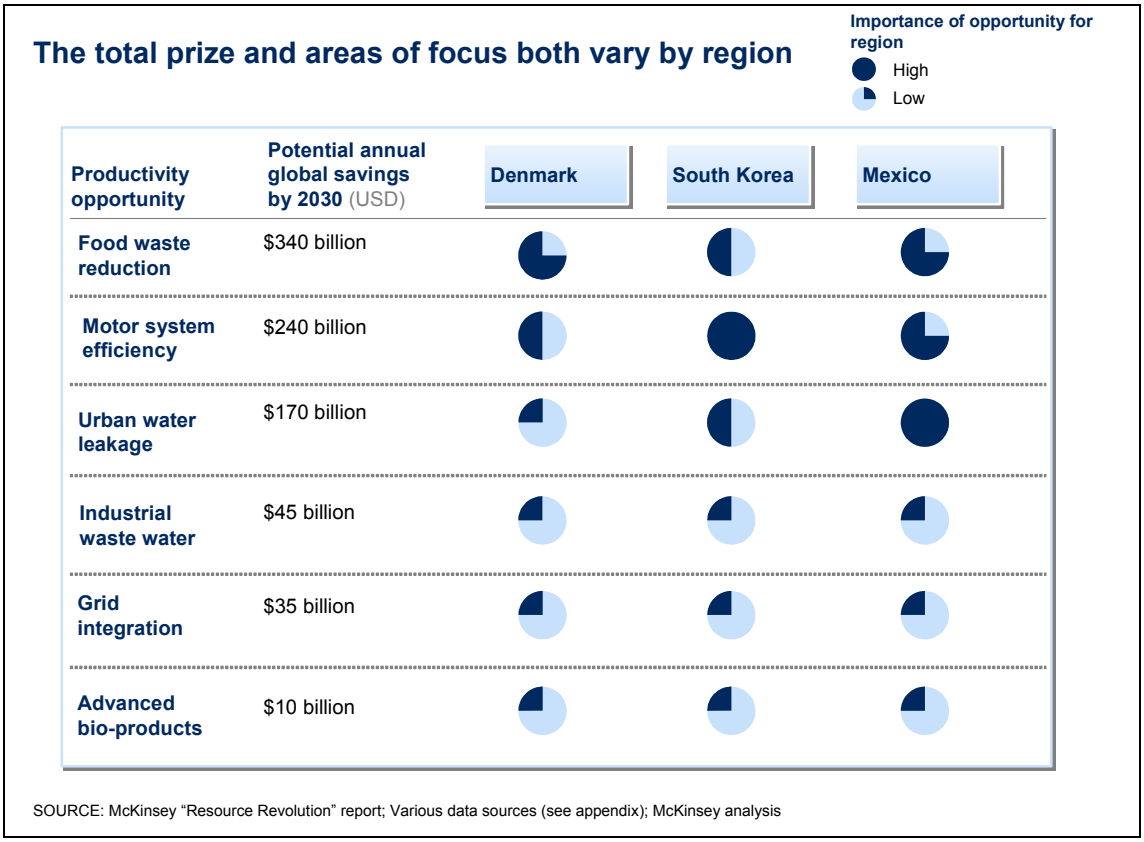
The cost-benefit ratio of each of these opportunities is less than one, implying that from a societal perspective these investments have a positive return.[9] Of the opportunities, motor systems, grid integration, urban water leakage and waste water reuse have the best societal returns. Advanced bio-based fuels and chemicals and food waste have lower societal returns, but it should be noted that food waste in nominal value has a relative high potential with 40 per cent share of the total global resource opportunities described here.

[8] Note that for grid integration, the resource benefits are assumed to be the energy savings costs and carbon benefits relative to a "less transmission" scenario. To manage intermittency, additional backup capacity from fossil fuel is assumed to be needed. The benefits could be higher, however, if the additional capacity was assumed to be additional renewable capacity. For more information, see "Power Perspectives 2030: On the Road to a Decarbonised Power Sector," 2011.

[9] Assuming a societal discount rate of 4 percent

In Denmark, Mexico, and South Korea, there are potential benefits from these global resource productivity opportunities, though the most important levers vary by country. The higher the resource productivity opportunities are in these three countries, the more of the respective pie charts are filled with the darker blue colour (Exhibit 8).

Exhibit 8



SOURCE: McKinsey "Resource Revolution" report; Various data sources (see appendix); McKinsey analysis

In Mexico, for example, the largest opportunity is likely to be in urban water leakage, with water loss in Mexico City estimated to be above 35 percent[10]. Mexico could reap significant savings if it can reduce its water leakage rates by 2030 to the current rates as for example seen in Germany of 7 percent. This could also produce energy savings for Mexico by reducing the energy requirements for sourcing, treating, and transporting water.

In Korea, the largest opportunity is in motor system efficiency, owing to the country's large manufacturing base. New motor systems are likely to be 20 percent more energy efficient, on average, than existing motor systems. Korea could thus achieve significant energy savings if it can increase the penetration of more energy efficient motor systems.

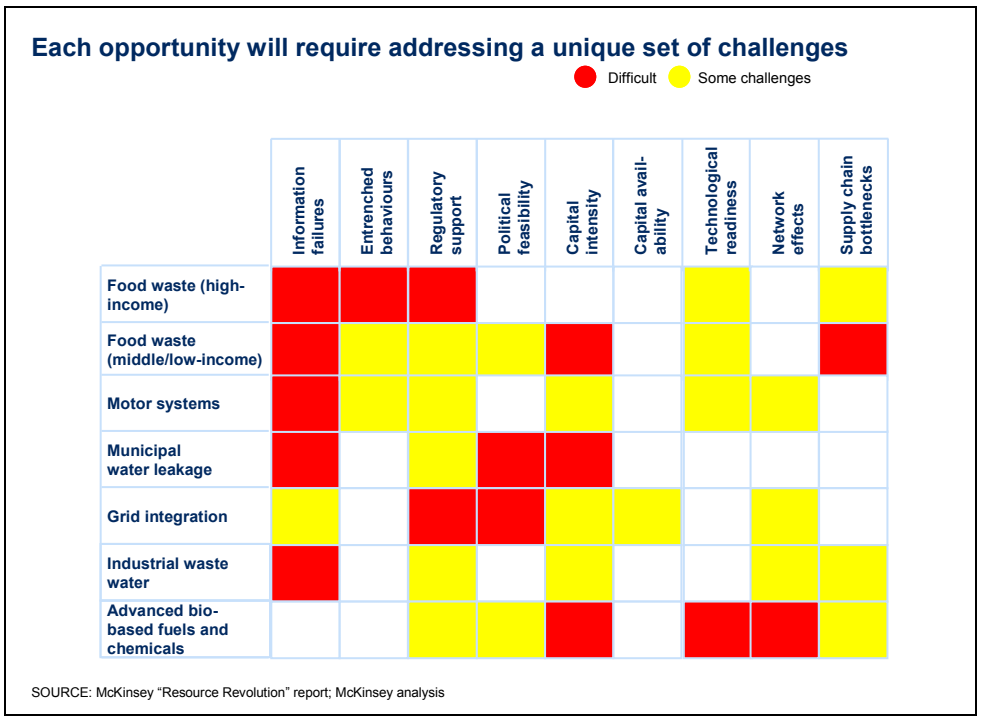
In Denmark, the largest opportunity is in reducing food waste. In Europe, the Food and Agriculture Organisation (FAO) estimates that over a third of fruit and vegetables get wasted in the value chain, with a further 16 percent lost by consumers. It should, however, be noted that in Denmark a large part of food waste goes in to incineration in district heating plants.

[10] Non-revenue water is estimated by Global Water Intelligence to be 45 percent in Mexico, which is assumed to include roughly 10 percent that is lost due to theft.

Capturing these opportunities will require overcoming a variety of barriers

Addressing these opportunities requires a customised approach that focuses on the specific difficulties of a given opportunity, whilst acknowledging the regional variances in barriers. While each opportunity faces a range of barriers, this analysis puts a deliberate focus on the most difficult barriers, which if addressed, could help to overcome the remaining barriers (Exhibit 9). The most difficult barriers for each opportunity covered in this paper are outlined below:

Exhibit 9



SOURCE: McKinsey "Resource Revolution" report; McKinsey analysis

- **Food waste (high income countries).** The major barriers to reducing food waste in high income countries (e.g., the United States and Europe) are ***information failures***, ***entrenched behaviours***, and ***regulatory support***. An important distinction is that these are the three critical barriers to address in *preventing* food waste and food losses along the supply chain. When it comes to another problem—addressing food waste that does occur, and redirecting it to productive sources—***supply chain bottlenecks*** emerge as a critical barrier as well. Information failures largely relate to the data available on food waste—the dearth of which stems from concerns about confidentiality for retailers and wholesalers and a simple lack of tracking mechanisms for farms and end users. These information failures, in turn, exacerbate entrenched behaviours by blinding the public to the scope of the issue. In addition, confusion over "sell by" and "display until" dates appears to cause considerable food waste. Research by the British PPP WRAP shows that 10-20 per cent of consumers rely on "use by" dates rather than their own sensory guidance to determine when to throw out food, even if that means disposing of food that is still safe to eat.[11] Entrenched behaviours occur both on the part of consumers and retail grocers:

[11] WRAP: "Consumer insight: date labels and store guidance," May 2011, p.

consumers can afford to waste food and have limited personal incentives to change their approach to buying and eating, while grocers profit by catering to consumer preferences (such as the preference for fully-stocked shelves) that directly lead to waste. Finally, regulatory support such as "Good Samaritan" laws—akin to those in the United States which clear grocers of liability for foodstuffs that they donate to charity— could clarify the liabilities surrounding food donation. Also, EU governments in many cases could rationalise legislation surrounding animal feed requirements—countries like South Korea and Japan, which have less onerous requirements, have been able to divert more waste to animal feed—which is a higher value end-point than composting or incineration.

- **Food waste (middle- and low-income economies).** The nature of food waste shifts to being significantly higher in the supply chain depending on the level of economic development and share of modern retail, in the food system for a given country. The barriers in middle and low-income economies are primarily ***supply-chain bottlenecks***, ***information failures***, and ***capital intensity***. More than 60 per cent of the opportunity lies in reducing perishable waste throughout the supply chain, and capturing this value will require the development of modern cold storage systems. A system of this kind with a capacity of 30,000 tonnes would have an annualized cost in China of more than $100 million. Supply-chain bottlenecks arise in part due to capital constraints, and in part due to information failures and a lack of visibility along the supply chain. Farmers, wholesalers, and retailers commonly lack confidence to invest if they do not believe that other players will make commensurate investments at other parts of the chain.

- **Motor system efficiency.** At least two critical barriers seem to block progress in improving the efficiency of motor systems. ***Information failures***—deriving in part from a lack of standards classifying the energy efficiency of motor systems—are reflected in the low awareness among managers of how much electricity could potentially be saved through optimized operations. ***Agency issues***, such as governance structures where managers are not incentivized to improve the life-cycle costs of the motors they buy, also block rapid progress—despite the fact that, for some motors, as much as 90 per cent of total lifetime costs come from electricity.[12]

- **Urban water leakage.** While several distinct barriers contribute to urban water leakage, three stand out as important ones to address. The first is ***political feasibility***. Addressing urban water leakage may have limited political upside and high potential downsides. Leakage is a hidden problem that does not generally disturb constituents unless their own service is cut off. Addressing the issue it often involves the politically unpopular moves of raising tariffs, cutting off unauthorized connections, and disrupting traffic during pipe repairs. Secondly, ***information failures*** come into play: there is a lack of transparency around the extent and location of leaks due to non-existent or insufficient metering and leak detection systems. Many cities' distribution networks are not divided into discrete zones, impeding efforts to isolate and locate leaks. With insufficient information on the leakage problem, it is difficult to target repairs and impossible to monitor progress towards reducing leakage. Finally, ***capital intensity*** is a major barrier, in

[12] WEG Electric Corp., "Three Phase Motor Manual and Product Overview," p. 2 or IEA's working report on "Energy-Efficiency Policy Opportunities for Electric Motor-Driven Systems", p. 72.

that replacing or repairing water distribution systems commonly requires high upfront capital investments—London, for instance, spent some £650 million replacing its aging Victorian mains system in recent years, and continues to invest £130 million per year in replacement and repair.

- **Waste water reuse.** The most significant set of barriers to improving water reuse rates, globally, is ***information failures***. Generally these information failures fall into one of two categories. First, industrial players have low awareness of opportunities for alternative sourcing of water for their industrial processes. Second, low awareness exists throughout the system about the true cost of water used in industrial processes. Most industrial players focus on the highly visible costs of sourcing water and disposing of effluent, but take less account of treatment and energy costs, or the value of the chemicals that the water carries through the industrial process. Industry research shows that true water-related cost can exceed the total price paid for water by a factor of 100.

- **Grid integration.** Three key barriers must be addressed as priorities in order to accelerate the pace of grid integration. First, ***political feasibility*** barriers in the form of lengthy and ineffective permitting procedures have increasingly delayed new high-voltage interconnectors, especially as local community opposition for health, environmental, and aesthetic reasons grows[13]. Second, there is a lack of a ***regulatory support*** that allows for new cross-border transmission projects to be justified to regulators based on comprehensive socioeconomic welfare criteria, rather than just on congestion rent. Third, cross-border interconnectors involve ***agency issues*** because they often result in an asymmetrical distribution of benefits which may lead to disagreements over how costs should be allocated across the jurisdictions involved. In some regions, there is also likely to be challenges with ***access to capital*** given the large investment requirements with €5 billion needed per annum up to 2020 which will increase to €7 billion.[14]

- **Advanced bio-based fuels and chemicals.** Barriers differ by stage of each bio-based process. In biofuel production, there are three key barriers: technology readiness, capital intensity and supply chain bottlenecks. The first 3-4 front-runner commercial scale plants will build experience and be vital for ***technological readiness*** reducing costs. ***Capital intensity*** of LC biofuel production is also an issue given the need to go from demonstration to industrial scale, as well as the failure to properly price carbon or other externalities (e.g., energy security implications) related to oil. Finally, developing advanced bio-refining will require closer links to agriculture production and the development of new business models to manage the interface between these two worlds.

  For bio-chemicals, uncertain **returns on investment** and **small size of the different final markets (except for a few big volume low margin chemicals like PE and PP)** are the major problem for further scale up as they are not cost competitive in most market segments with petrochemical based alternatives. While there is a small proportion of customers claiming their willingness to pay a reasonable premium for products such as bio-based plastics or chemicals, finding sizeable markets (that would enable significant cost reductions through scale-induced learning benefits)

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[13] ENTSO-E 10-Year Network Development Plan 2012: Project for Consultation," ENTSO-E, March 2012.

[14] European Climate Foundation, "Power Perspectives 2030: On the road to a decarbonised power sector," 2011.

may be difficult. Attention will be therefore first given to the sub-set of processes able to be cost competitive (or close to) from the start.

Cross-cutting initiatives could play a significant role in most of the opportunities

Across each of these opportunity areas, there are a set of implications for cross-cutting initiatives such as cities, public procurement, international trade, and finance. The relevance of these cross cutting initiatives varies by opportunity and is discussed in more detail in the appendix. The most salient implications for each of these cross-cutting initiatives will now be addressed in turn:

- **Cities.** The role of cities has a significant role in 3 of the 6 reviewed opportunity areas. Addressing urban water leakage is inherently a city-relevant issue. Leakage rates vary significantly between cities within a country. For example, in Mexico, the city of Monterrey has non-revenue water of 29 percent compared to Mexico City which has non-revenue water rates of 45 percent. Addressing this issue requires engagement with the local water utilities and municipal governments to plan for necessary renovations. Reusing municipal waste water in industrial settings requires engagement with local wastewater treatment plants and potentially incentivising them to identify opportunities to supply local industrial sites with treated water. Finally, in food waste within high-income countries, the creating of a reverse supply chain requires city-level coordination in order to build sufficient scale for the economics of the business to be attractive. In each of these opportunities, city-based partnerships such as the C40 could play a role in helping drive international impact for opportunities that must necessarily be multi-local.

- **Finance.** The public sector can play a role in helping mitigate the risk of potential investments to create an environment where private investment in these resource productivity opportunities is more viable. The public sector can help mitigate the risks to capital, such as policy risk, technology risk, and for foreign investors, foreign exchange risk. There is also a role for helping the development of local capital markets in lending to these new areas of resource productivity opportunities, given that up to 85 percent of resource productivity opportunities are in developing countries, where capital markets may be relatively weak.[15] In particular, there is often a high cost of debt (linked to local financial sector being relatively unfamiliar with the risks and opportunities linked to these new lending areas and being unable to appropriately 'cost' debt financing); short loan durations; and a lack of liquidity – particularly since the global financial crisis. There is a role for encouraging local financial institutions to see these resource productivity areas as a commercial opportunity, by incentivising local financial institutions through (a) providing capacity building support (e.g., credit analysis, support with financial product development, sector studies); and (b) offering loan guarantees (e.g. portfolio loss guarantees) and other co-financing instruments to incentivize local financial institutions to set up new lending lines by reducing perceived risk exposure and increasing potential returns. For example, the International Financial Corporation (IFC) has recently launched a challenge fund in Vietnam that provides $20 million of

[15] Resource Revolution: Meeting the world's energy, materials, food, and water needs, McKinsey Global Institute and McKinsey Sustainability and Resource Productivity practice, November 2011

loans through local financial institutions, and which provides reduced interest costs if local financial institutions match this with a certain share of their own financing.[16]

- **Public procurement.** Public procurement can play a role in providing reliable demand for new products as well as helping drive scale. In motors, for example, the United States uses its Federal Energy Management Program to encourage federal agencies to purchase products which are among the highest 25 percent of equivalent products for energy efficiency. [17] Since 2006, this program has supported the most efficient class of motors, IE3, to help scale up demand.[18]

- **Trade.** The Sustainable Energy Trade Agreement (SETA) is aims to remove trade barriers that impede the rate of innovation, diffusion, and cost of non-fossil fuel energy sources. Open trade in advanced biofuels is likely to be particularly important to global scale up given the restricted capacity some countries have to produce biofuels domestically and the likely variation in efficiency of production between countries.

[16] Project Catalyst, "Making Fast Start Finance Work," June 7, 2010

[17] Federal Energy Management Program, "FEMP Designated Product: Electric Motors"

[18] Waide and Brunner, "Energy-Efficiency Policy Opportunities for Electric Motor-Driven Systems," 2011

Methodological Appendix

Sizing of opportunities

The sizing of the opportunities is based on the methodology outlined in McKinsey's *Resource Revolution: Meeting the world's energy, materials, food, and water needs*. The annual resource benefits represent the resource savings, including the "priced" benefits of resource efficiency (e.g., the energy saved times the energy price) but also the "non-priced" societal benefits such as carbon savings and adjustments for subsidies.

Sizing of linkages between resources

For each opportunity, the linkages with other resources is calculated and included in the total resource benefits. For example, by saving energy an opportunity also saves carbon (based on the relative carbon intensity of the energy source) and water (used in the extraction and conversion of that energy source). Only material linkages are considered and for the sake of simplicity, these linkages are only considered for a single iteration (e.g., the energy used to produce the water that was used to produce the energy is not included). Linkage savings are calculated based on the quantity of each resource saved (Table A1) times the difference between the societal and investor price for a given resource.

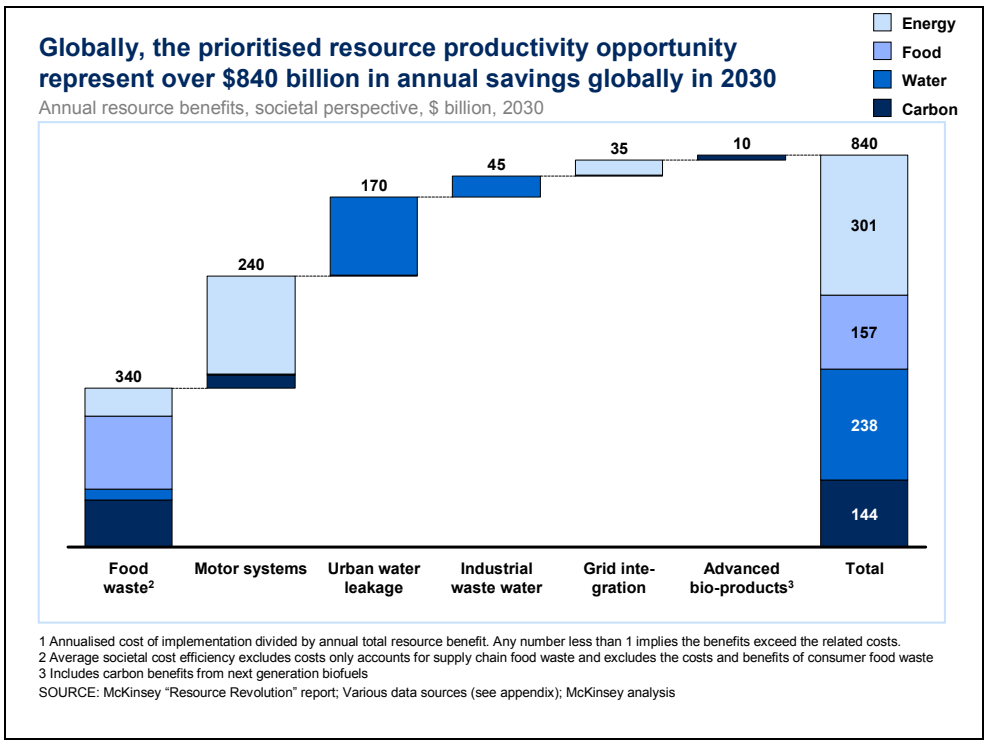
Table A1

Resource	Linkage calculated	Key assumptions
Energy	Carbon	Carbon savings based on carbon intensity of a given fuel source. When electricity is saved, carbon savings are assumed based on the carbon intensity of the country's energy supply mix.
Energy	Water	Water savings based on the average water intensity of energy production. All water savings are assumed at industrial water prices.
Water	Energy	Energy savings based on the average energy intensity of water production for agricultural, industrial, and municipal water separately.
Water	Carbon	Carbon savings based on the average carbon intensity of energy multiplied times the water/energy linkage.
Land	Energy	Energy savings based on the average energy use per hectare including both the energy used in production (e.g., fuel for tractors) plus the energy embedded in fertilisers and pesticides. Where a given lever requires additional energy (e.g., increased yields) this is netted from the benefits.
Land	Carbon	Carbon savings based on the energy savings at the average carbon intensity of the fuel source plus the avoided deforestation.
Land	Water	Water savings based on the average water use per hectare

Savings by opportunity

Some opportunities capture benefits not just in food but also water and energy. These are calculated by understanding the linkages between resources. In the specific case of food waste, waste at the later stages of the supply chain represent embedded energy. For example, the energy of end-user food waste is roughly 8 times that of post-harvest waste (Exhibit A1).

Exhibit A1



1 Annualised cost of implementation divided by annual total resource benefit. Any number less than 1 implies the benefits exceed the related costs.
2 Average societal cost efficiency excludes costs only accounts for supply chain food waste and excludes the costs and benefits of consumer food waste
3 Includes carbon benefits from next generation biofuels
SOURCE: McKinsey "Resource Revolution" report; Various data sources (see appendix); McKinsey analysis

Pricing assumptions

All prices are based on 2010 averages. Similar to the resource revolution report, with the exception of energy where regional prices are used, resource prices are assumed at a global level.

Table A2

Opportunity area	Unit	Price from societal perspective	Source
Water	$ / cubic meter	**Global unsubsidised:** Global Industrial – $0.9 Global Agricultural - $0.1 Global Municipal - $1.5 **National:** Mexico Industrial - $0.26 Mexico Agricultural - $0.26 Mexico Municipal - $0.49 Korea Industrial - $0.07 Korea Agricultural - $0.02 Korea Municipal - $0.48 Denmark Industrial - $8.83 Denmark Agricultural - $8.83 Denmark Municipal - $8.83	**Agricultural water:** FAO, 2030 Water Resources Group (WRG) **Industrial water:** OECD, WRG **Municipal water:** Global Water Intelligence (GWI), WRG **Regional:** Korea Water Resource, Renewables Grid Initiative (RGI)
Electricity	$ / gigawatt hours (GwH)	Global unsubsidized: $108 Mexico unsubsidized: $149 Korea unsubsidized: $144 Denmark unsubsidized: $161	**Global:** Enerdata, IEA **Mexico:** CFE, Economist Intelligence Unit **Korea:** KEPCO **Denmark:** Energitilsnet
Carbon	$ / tonne	Unsubsidised: $30 Subsidised: $0 (Same across Mexico, South Korea, Denmark)	McKinsey Greenhouse Gas Abatement Cost Curve
Food	$ / tonne	Perishable: $305.30, globally Non-Perishable: $209.70, globally	FAO, OECD
Advanced bio-products	$	Gasoline: $3.64 / gallon Ethanol: $2.095 / gallon	EIA

Sizing assumptions

The resource benefits of productivity opportunities are sized based on potential improvements at a "reasonable level" based on case studies or benchmarking of performance relative to peers.

Table A3

Opportunity area	**Resource benefits** $bn, 2030	**Key global sizing assumptions**	**Country and regional sizing assumptions**
Food waste	340	**Supply chain waste:** high-income countries reduce 8% of end supply chain waste; low- and middle-income countries achieve 50% of packaging/distribution waste of developed countries **Postharvest waste:** low- and middle-income countries meet 50-80% of postharvest waste performance of high-income countries, depending on food type (perishable vs. non-perishable); no base-case productivity improvement assumed due to lack of historical data **End-user waste:** 30% reduction assumed for high-income economies; no reduction assumed for low- and middle-income countries	**Regional sizing:** Global sizing broken out by production by country and food waste by region from FAO. **County sizing:** Based on country-level production data and improvement assumptions benchmarked to best practice countries. **Mexico:** Improvement in post-harvest handling and storage possible across all food categories; processing and packaging improvement potential for Oilseeds, Fruits & Vegetables; distribution improvements across almost all categories **S. Korea:** Post-harvest and handling improvement potential for cereals, roots and tubers, and fruits & vegetables; packaging improvements in cereals and roots & tubers; and improved distribution potential for meat and roots & tubers **Denmark:** Post-harvest savings potential across all food categories; processing/packaging improvements in cereals and roots & tubers (including 12% waste reduction potential in roots & tubers); and distribution improvement potential for fruits & vegetables and roots & tubers

Table A3 Cont.

Opportunity area	**Resource benefits** $bn, 2030	**Key global sizing assumptions**	**Country and regional sizing assumptions**
Urban water leakage	170	Case study results extrapolated to rest of world based on their level of development and starting point on leakage (e.g., 5% reduction in South Africa, 16% in Brazil) Non-revenue water percentages: 45% for Mexico, 18% for Korea, 10% for Denmark Theft assumed to be 10% for Mexico and 0% for Korea and Denmark Opportunity calculated by assuming that countries will be able to achieve a 7% leakage target (the current rate in Germany) by 2030 BAU leakage rates assumed to be the same as current rates	Monetary size of country-specific opportunities calculated using unsubsidised prices for the primary resource (municipal water) and the difference between the unsubsidised and subsidised prices for inter-linkage savings in the form of energy and carbon emissions Country-specific prices for water, electricity, and carbon stated in Table A2
Industrial motor systems	240	Analysis of the motor systems market shows the potential to save $240 billion annually by 2030 equalling to a roughly 10 per cent reduction from business-as-usual electricity use by the manufacturing sector. Information is based on McKinsey Carbon Cost Curve v2.1, with local prices for electricity (as shown in Table A2). New motors systems are assumed to have a share of 60-65% of the electricity consumed in the industry sector (varying by country). The savings were separated by replacement of industrial motors with more efficient systems, and retrofit of old motors. Each year, it is assumed that 5% of motors get retired. Of the replacement motors, on average 20% (varying by country) are assumed to be high energy efficiency in the business-as-usual (BAU) scenario; in the productivity case, this increases to 30% in 2015, to 50% in 2020 and 100% in 2030. New efficient motors are assumed to be 20-25% less energy intensive (varying by country). The BAU penetration of retrofits is assumed to 10-30% for all years up to 2030, depending upon the region. In the productivity case, the penetration of retrofits is assumed to be 50% in 2015, reaching 100% in 2020 and the remaining years till 2030.	Local electricity prices used to calculate savings. **Mexico:** New motors assumed to be 25% less energy intensive. Motor systems share of electricity used assumed to be 60%. Penetration of efficient motors in new purchases and retrofits assumed to be 10% in BAU, rising to global average in productivity case thereafter. **Denmark:** New motors assumed to be 20% less energy intensive. Motor systems share of electricity used assumed to be 65%. Penetration of efficient motors in new purchases and retrofits assumed to be 30% in BAU, rising to global average in productivity case thereafter. **Korea:** New motors assumed to be 20% less energy intensive. Motor systems share of electricity used assumed to be 60%. Penetration of efficient motors in new purchases and retrofits assumed to be 30% in BAU, rising to global average in productivity case thereafter.

Table A3 Cont.

Opportunity area	**Resource benefits** $bn, 2030	**Key global sizing assumptions**	**Country and regional sizing assumptions**
Advanced bio-based fuels and chemicals	10	Industry estimates of LC biofuel production are for 60 billion gallons per annum by 2030. This is based on expected installed capacity in 2020 of approximately 5 to 10 billion. Experience with first generation biofuels suggests adding approximately 5 billion per year is feasible and is therefore assumed between 2020 and 2030. Using the carbon emissions from ethanol compared to oil and adjusting for differences in energy intensity, the carbon reduction is calculated.	Country savings are generated based on the projected size of the gasoline market in 2030 and the proportion of that market which LC ethanol could capture given government policy direction and biomass availability. **Denmark:** it is assumed that 30 percent of gasoline demand will be captured by LC ethanol in 2030. **South Korea:** it is assumed there will be limited LC ethanol until 2025 as there is a strong focus on biodiesel. By 2030, 10 percent of gasoline demand will be captured by LC ethanol. **Mexico:** it is assumed that 20 percent of gasoline demand will be captured by LC ethanol in 2030.
Grid integration	35	Based on carbon and energy price benefits on a levelised cost of electricity (LCOE) basis from the *Power Perspectives 2030*[19] report in Europe. Sized based on the incremental difference between the "Less Transmission" and "On Track" scenarios. Extrapolated to global savings based on Europe's share of the world's energy production, and the proportion of the world's production occurring in countries greater than 25% renewable penetration in capacity terms.	Denmark's sizing is based on opportunity size in Europe, scaled down according to Denmark's share of expected 2009-2030 renewable capacity build-out Other region's sizing is based on global sizing, scaled down according to each region's share of the world's expected 2009-2030 build-out.
Waste water reuse	45	Base case from Global Water Intelligence forecast for 2015, extrapolated to 2030 by region; in the productivity case collection, treatment, and reuse assumed to reach top quartile for high-income countries, mid-quartile for middle-income countries, and bottom quartile for low-income countries	Industrial waste water reuse opportunity for Mexico based on information from the Water Resources Group 2030. Potential for Denmark and South Korea derived from the potential of Western Europe and Asia Pacific regions, then scaled to country level using the ratio of industrial water use to the respective region

[19] European Climate Foundation, "Power Perspectives 2030: On the road to a decarbonised power sector," 2030.