

LOKAL IS BEAUTIFUL

ECONOMIC LEAKAGE AND RELOCALIZATION:
OPPORTUNITIES FOR SUSTAINABLE PROSPERITY IN MAURITIUS



#Maker

#Circular

#Smart

How can Mauritius develop its economy from the inside via local demand and turn the realities of economic leakage into opportunities for growth by following the lead of inspiring entrepreneurs?

*A study commissioned by the MCB
& conducted by UTOPIES – January 2019*

EXECUTIVE SUMMARY



For over 180 years, MCB Group has been true to its guiding principle of assisting in the advancement of individuals, corporations and the country at large by supporting entrepreneurship and innovation on the island.

However, in the last 10 years global challenges such as the economic crisis and global warming have sparked a deep questioning within the organization as to the very meaning of development, reexamining commonly held definitions of prosperity and happiness to redefine the group's responsibilities as an active steward of the island's economic growth.

A number of more agile and enthusiastic movements are emerging on the island (Slow Food, Slow Money, Local first, Fablabs...) which promise new models of innovation and prosperity.

The MCB Group seeks more than ever to serve the development of Mauritius, a traditionally entrepreneurial island, by exploring new avenues to achieve greater prosperity from the inside out. The question is not to aim for complete self-reliance or to cut the island off from the world in search of self-sufficiency, nor to deny the importance of exports (goods, services), tourism or international investment for our island's economy. Rather the question is to reinforce the solidity of the island's economy by anchoring it in a new kind of globalization, one of exchanges between prosperous countries.

This study set out to better understand how prosperity is achieved on the island and identify which mechanisms create wealth and how much of it is generated from local economic circuits.

Our findings show that attracting external wealth is an important and necessary pillar of Mauritius' economy, however attraction of external wealth alone does not account for nor sustain the island's prosperity.

Indeed, not only does Mauritius' wealth rely on the island's capacity to attract international income (exports, income from labour and capital), it also depends on the country's ability to circulate wealth locally: income entering the island generates more wealth locally, which generates new exchanges and income in a virtuous cycle, until this ripple effect fades. This is what we call the local multiplier effect.

Mauritius' prosperity results from its ability to attract international wealth and maximize the island's local multiplier effect. For instance, in 2015 Mauritius attracted 3,42Bn USD in international income. The local multiplier effect allowed for a 2,86 factor amplification of this wealth, achieving a total of 10Bn USD in national income.

Mauritius' case is not unique. Indeed, international research shows that national prosperity is hard to achieve without a successful combination of international attractiveness and a strong local multiplier effect.

The goal for Mauritius is to gain sustainable entry to the club of high-income countries, a goal which the island will not be able to reach anytime soon unless it increases its local multiplier effect.

Yet, while Mauritius' external income has registered strong growth on average for the last 20 years, the country's local multiplier effect has tended to decrease (-25% in 10 years).

Hence fostering the island's development calls for a two-pronged approach focused on Mauritius' capacity to continue attracting external wealth and its ability to circulate this wealth within the island as sustainably as possible. In practice this would require:

1

Fostering local response to local demand by increasingly producing in Mauritius what is no longer or insufficiently produced on the island;

2

Increasing income derived from local knowledge and heritage savoir-faire, by increasing the complexity of the island's production.

Aiming to increase Mauritius' local multiplier effect has nothing to do with advocating for protectionism and higher tariff barriers, which in a globalized and reciprocal economy would be counterproductive. Rather, the island should find ways to stimulate new forms of local entrepreneurship and foster the emergence of new local industries. This is necessary in order to ensure Mauritius' inclusion in a globalized economy and guarantee sustainable growth for the island.

3 avenues can be explored to foster the emergence of this kind of entrepreneurship on the island:



Making Mauritius a “maker island” means increasing its ability to produce what it consumes using local resources (human, material, technical, natural).



“Looping the loop” of local economic and material circuits to make Mauritius a “circular island” can be a powerful generator of wealth and innovation.



What if the island’s economic intelligence consisted in creating value rather than products?

However, these new avenues for economic development must be designed to fight climate change. It is urgent to reduce the climate impact of our lifestyle and consumption, and thus reinforce the resilience of the island of Mauritius. Developing local manufacturing without increasing the island's ecological footprint must stem from new, more sustainable production models which contribute to solving global environmental challenges.

At MCB, we are inspired by these new models to rethink our role as an active steward of economic development, imagine new services, generate new kinds of collaborations, support local creativity and foster the emergence of local manufacturing as a means of guaranteeing sustained prosperity to the island of Mauritius.

For us, this report is also a contribution of the MCB Group to our island and its inhabitants, as well as an invitation to dialogue, to build together the prosperous, sustainable and resilient Mauritius of tomorrow.

LOKAL IS BEAUTIFUL

AN INVITATION TO DIALOGUE

« LOKAL IS BEAUTIFUL provides an excellent foundation for focusing on the importance of incentivising local production of complex goods in order to encourage local solutions to local needs. The report meaningfully considers the inter-linkages of international revenues, local revenues, the goals of a high income economy and a sustainable development model, the value addition requirements for the country and the carbon footprint (...) It also proposes an economic development model which is resilient, sustainable and inclusive as well as the overall objectives of individual and collective well-being. This would surely form part of the ambition of a modern and forward-looking Mauritius. For the MCB, this could provide a new perspective on facilities to be provided to this emerging economy. This may include flexible products to meet the needs of the insular entrepreneur as well as blockchain and Fintech solutions to service an emerging market with agile customers and producers. The bank may also consider means of accompanying local industries in their transformation towards more complex products, through blended facilities, risk-sharing mechanisms and financial advice. »

Kevin Ramkaloan, *PDG, Business Mauritius*

« Mauritius, a small island nation off the east coast of Africa, is neither particularly rich nor on its way to budgetary ruin,” wrote the Nobel-prize winning economist Joseph Stiglitz in 2011, in an op-ed for the British newspaper, The Guardian. “Nonetheless, it has spent the last decades successfully building a diverse economy, a democratic political system and a strong social safety net. Many countries, not least the United States, could learn from its experience.” Among the facts that impressed Stiglitz were that 87% of residents owned their homes, 100% had access to free education and health care, and the country paid for all this, not by exploiting one natural resource like oil, but by growing a diversified economy growing at 5% per year for three decades.

Mauritius is admirably not content to rest on what the island has accomplished over the past thirty years and now seeks to raise the income and standard of living of its citizens further. It wants to enter the club of high-income countries with a world-class model of sustainability. And perhaps the island's planners are aware that if they, an island economy with limited natural resources can achieve such a success, every country in the world could follow this model.

The commissioning of LOKAL IS BEAUTIFUL by the MCB Group represents a huge leap forward in achieving this objective. The scholars at Utopies, a Paris-based think tank, have produced a groundbreaking analysis about the challenges and opportunities facing the Mauritius economy. They make a compelling case for rethinking the country's future with three goals: a Maker Island that increases local production; a Circular Island that increases local purchasing; and a Smart Island that fosters more local innovation. »

Michael H. Shuman, *Economist, lawyer, author and entrepreneur. Expert in community economics*

« Place and culture are the New Economics. What is needed is a compelling Place vision, brand and story for a 21st century Mauritius. An island that could be a new model of resilience, harmony, happiness, wellbeing and regenerative growth for the world. All the ingredients are there. And the LOKAL IS BEAUTIFUL report challenges business as usual to embrace a larger community engagement and participation model - so that an empowered community can be unleashed with its creative capacity for positive change. »

Gilbert Rochecouste, *Activist & Entrepreneur*

To see all the comments collected on the report and to build the suite with us
visit Lokalisbeautiful.mu

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PART I:

Understanding and redefining prosperity in Mauritius

1.1 The balance of prosperity

While wealth creation can no longer be the sole measuring stick of a country's prosperity, its standard of living and income remain cornerstones of prosperity nonetheless. Focusing on wealth creation on one hand and individual well-being and happiness on the other no longer makes sense. The challenge for Mauritius is to define a broader vision of success (beyond figures) while aiming to sustainably become a high-income country.

To this end, it is of prime importance to understand how Mauritius' national income is generated so as to harness its potential to achieve a broader kind of prosperity.

1.1.1 International wealth attraction, an indispensable pillar of the Mauritian miracle

When it comes to promoting a country's development and prosperity, increasing incoming wealth (exports, tourism, capitals, new residents, ...) tends to be the main focus. Development agencies in particular have traditionally focused their efforts on attracting such external income.

This international income is defined as the sum total of all income generated by the island's attractiveness or international competitiveness, including exports of goods and services, tourism-related expenditure, international aid and public transfers received from governments, income and other transfers received by households, income derived from direct investments, foreign financial portfolios and loans (principally dividends and interests, excluding offshore activity).

Take 2015 (the most recent year for which homogeneous and comparable data collection was conducted allowing for econometric assessments¹), Mauritius' national income, i.e. the overall income of agents residing on the island of Mauritius (income from labour, capital and other financial transfers) stood at approximately 9,76Bn USD.

¹ See methodological note

That year, international wealth attracted by Mauritius reached 3,42Bn USD, including 4 different types of external wealth:

- Exports of goods (not including re-exports, only taking into account goods produced on the island, except for goods bought by tourists): 1,66Bn USD of exported goods (equivalent to 971M USD in income)
- Tourist spending² (purchases of services and goods): 1,87Bn USD of spending (equivalent to 1,05Bn USD in income)
- Exports of services (except tourism), in particular other services sold to companies and financial services sold to non-residents: 1,22Bn USD of sales (equivalent to 744M USD in income)
- Income (labour, capital), international aid and other transfers received from abroad by residents, excluding offshore incomes: 835M USD transferred (equivalent to 655M USD in income).

Though highly necessary, is this attraction of external wealth enough to guarantee high income for Mauritians? **No: As in a bucket with a hole in it, this external income will only remain on the island if Mauritius is able to retain this wealth by avoiding economic leakage.**

² Including business and other kinds of tourism (e.g. health)

TOTAL INTERNATIONAL
INCOME
3,42Bn USD

Exports of services
(including Global Business,
excluding tourism)
Flow: 1,22Bn USD
Income: 744M USD

Tourism
Flow: 1,87Bn USD
Income: 1,05Bn USD

Exports of goods
(excluding re-exports)
Flow: 1,66Bn USD
Income: 971M USD

Income (labour, capital), international aid
and other transfers received from abroad
by residents, excluding offshore incomes
Flow: 835M USD
Income: 635M USD

Main economic leakages:
imports, labour and capital
paid abroad



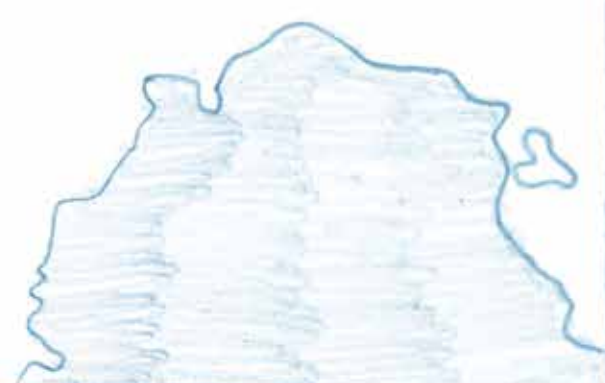
Attracting international income: a necessary but insufficient pillar of prosperity
"The leaky bucket"

1.1.2 Mauritius' income depends on the island's capacity to attract wealth and circulate it locally

More than just attracting and retaining wealth on the island, Mauritius must find ways to multiply it. Attracting approximately 3Bn USD of international wealth in 2015, how did Mauritius manage to generate approximately 10Bn USD in income that year? In other words, does the same flow of international income to two different countries result in similar levels of national income?

Experience shows that many other factors come into play and that two countries attracting similar flows of international wealth will not generate the same levels of income. Indeed, a country that is able to sustainably circulate wealth within its economy will be more prosperous than a country with less dynamic local economic circuits. **What makes the difference is the local multiplier effect.**

The local multiplier effect reflects a country's capacity to durably circulate wealth injected from abroad within its economy. As with a game of pinball, scoring highly requires that a player maintain the ball in the game as long as possible and circulate it with the help of impulse mechanisms that maintain and direct it within the game (away from the fatal exit), so as to increase the score and win extra-balls (or credits) which in turn allow to extend the game and increase the final score. The local multiplier effect works in the exact same way: external income enters local economic circuits, circulates within them (in particular if the economy is diverse and features impulse mechanisms such as banking credit), generates local income and hence further cycles of potential spending via household or public-sector expenditure and investments (*extra-balls*).



LOCAL
MULTIPLIER
EFFECT
X 2.86

LOKAL IS BEAUTIFUL

Total national income
after circulation
10Bn USD

INDUSTRIES

COMMERCES

CROISSANCE

INVESTISSEMENTS

External income
3Bn USD

EMPLOI

External income

The local multiplier effect, or « pinball effect », will be higher if external incomes don't exit the country too fast, for instance in the form of imports or salaries (see the bucket image above).

Hence Mauritius' national income boils down to the following equation:

$$\text{NATIONAL INCOME} = \text{INTERNATIONAL INCOME} \times \text{MULTIPLIER}$$

In 2015, Mauritius' economy attracted 3,42Bn USD of international income and generated an overall national income of 9,76Bn USD, featuring a 2,86 multiplier. For each USD of income attracted from abroad and secured by residents, Mauritius is able to produce an additional 1,86 USD of income within the island's economy.

Breakdown of the multiplier effect's impacts on the island of Mauritius

National income (9,76Bn USD) =
International income (3,42Bn USD) x Multiplier (2,86)
Or per capita: 7 731 = 2 703 x 2,86



		Millions \$ 2015
International income	First line industries (exports, banks, investors, State)	3 420
Impact primaire (Round 1)	Chain of suppliers of first line industriesa	1 021
	Induced household spending	1 574
	Induced public spending	558
	induced investments (private, public)	284
Secondary impact (round 2 and beyond)	Round 2 - Use of income from Round 1	1 407
	Round 3 - Use of income from Round 2	826
	Round 4 - Use of income from Round 3	488
	Round 5 - Use of income from Round 4	291
	Round 6 - Use of income from Round 5	175
	Round 7 - Use of income from Round 6	261
Economic Leakage	Income from work and capital paid abroadr	540
National income		9 765
Multiplier		2,86

Source: Estimates by Utopies based on the agency's 2015 input-output model

NB: This study takes into account offshore activities licensed under the Global Business Licence (GBL) since they deliver services in Mauritius as « resident » service providers, unlike offshore financial flows, which are not included in this study as they don't actually enter nor feed Mauritius' economy. Similarly, re-imports and re-exports that don't enter Mauritius' productive circuits are only accounted for as commercial margins and are not counted as flows entering or exiting the island's economy.

Mauritius' example illustrates that economic growth relies on 2 pillars: attraction of international income and its circulation within the local economy. **Hence the challenge lies in articulating these two wealth creation processes strategically, rather than only seeking to increase international income or to enhance local exchanges.**

Considering that Mauritius will definitely not achieve high income if it does not successfully position itself within globalization, **guaranteeing the island's position among high-income countries calls for a high multiplier effect** (see frame below).

The local multiplier effect accounts for a third of prosperity gaps between developed countries

We have analyzed 82 upper-middle- to high-income countries as defined by the World Bank seeking to understand the contributions of each country's external income and net local multiplier to its national per-capita income. Certain statistically extreme cases (countries which derive a high percentage of their external income from the financial sector; oil-producing countries...) were not included in this study.

The resulting explanatory model³ (which allows to predict national income with an average forecasting error margin of under 5%) leads to the conclusion that a country's prosperity depends on its capacity to effectively combine external wealth attraction with a high local multiplier effect.

This analysis establishes the relative weight of these two variables in the prosperity equation: on average, external income accounts for 2/3 of a country's prosperity, while the multiplier effect accounts for 1/3 of income variability between different countries. **Attracting external income is necessary but not sufficient to make a country more prosperous, the vitality of a country's economic circuit constitutes another indispensable condition for achieving high income.**

³ Per capita income = 12,753 USD + 3.31 External per capita income + 3502 Net multiplier (R² = 0.879)
Data collected/processed by Utopies based on World Bank and IMF statistics as well as the EORA database
(Year 2015, in current USD)

1.1.3 Mauritius' economy and the scissors effect

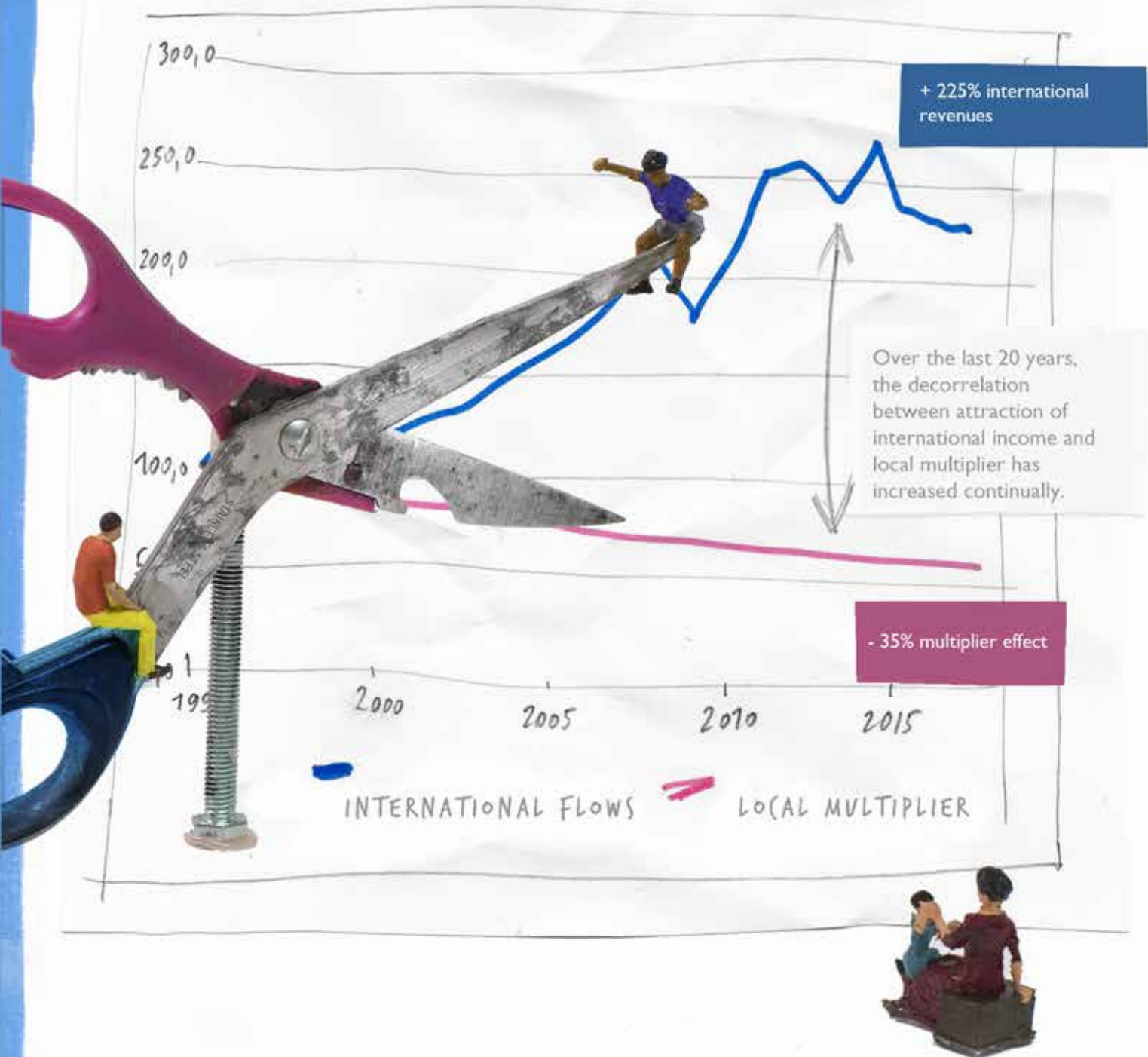
Mauritius' international income has risen 27% over the last 10 years, even though this growth has been unstable, as shown in the graph below.

At the same time, the island's local multiplier effect registered a 25% drop, from 3,88 in 1995 down to 2,86 in 2015.

The decorrelation between Mauritius' attraction of international income and the island's local multiplier, the so-called scissors effect, has increased continually between 1995 and 2015, creating a striking and rather worrying discrepancy between the island's 225% growth in international income and 35% drop of the local multiplier.

EVOLUTION OF MAURITIUS' LOCAL MULTIPLIER					
1995	2000	2005	2010	2015	
3,88	3,52	3,15	2,92	2,86	

Source: Estimates by Utopies based on the agency's 2015 input-output model



Graph: The scissors effect: Evolution of international flows and the local multiplier, 1995-2015;
Source: Stats MU and estimates by Utopies

1.2 Why is Mauritius' local multiplier effect dropping?

The multiplier effect of a country depends in particular on :

- **Economic leakage:** in particular due to imports, which constitute lost income for the country's local economic circuit at every step of the spending cycle;
- **International income (in particular exports) that effectively benefit the country:** particularly exports which feature strong added value, i.e. sophisticated products which stimulate the whole country's economy by generating an entire export-oriented local industry.

1.2.1 Imports of goods and services account for 59% of Mauritius' GDP

Leakages of wealth previously injected into the local economy are the main reason behind the decrease in Mauritius' local multiplier effect. **Imports are by far the 1st source of leakage for Mauritius**, ahead of capital or income leakages.

The higher the import ratio, the weaker the ripple effect of international income on local spending, the weaker the circulation of income on the island.

It is to be noted that Mauritius' balance of payments is in the green while the country's trade balance is in the red (almost -2Bn USD in 2015), hence **the issue lies within Mauritius' real economy, not the island's financial economy.**

For which kinds of spending is Mauritius most dependent on foreign imports?

Three main purchasing categories feature a particularly strong dependence on foreign suppliers: Petroleum / Chemicals / Construction materials, Electrical and machinery and Transport equipment.

% OF DEMAND IMPORTED (2015)

Demand of Households, businesses, public administrations and non profit institutions

Agriculture	27%
Fishing	75%
Food & Beverages	31%
Textiles and Wearing Apparel	59%
Wood and Paper	58%
Petroleum, Chemical and Non-Metallic Mineral Products	86%
Metal Products	73%
Electrical and Machinery	88%
Transport Equipment	85%
Other Manufacturing	53%
Electricity, Gas and Water	1%
Construction	7%
Maintenance and Repair	19%
Wholesale Trade	2%
Retail Trade	2%
Hotels and restaurants	10%
Transport	39%
Post and Telecommunications	24%
Financial Intermediation and Business Activities	17%
Public Administration	1%
Education, Health and Other Services	5%

Proportion of Mauritian demand covered by imports; Source: Estimates by Utopies

With regard to these 3 sectors, Mauritian production covers less than 15% of the island's demand.

Fishing is 4th most important sector of imports in Mauritius. The island's fish industry features a noteworthy mode of operating. Indeed, though fishing exports stood at 111M USD in 2015, 88% of these were re-exports. While the island's own annual production of fish stood just under 40M USD, exports of fish products fished by Mauritian boats reached 6,7M USD. In 2015, Mauritius covered just about 25% of its own demand in this sector.

To better understand the dynamics of Mauritius' imports it is necessary to identify the island's main "buying" sectors for each "supplier" sector. This is what is called exchange knot analysis, which establishes the volume and sector of imports for each kind of economic player – private sector companies, households or public administration.

MAURITIAN IMPORTERS	FOREIGN EXPORTERS TO MAURITIUS	IMPORTS VALUE (Producer prices) - Millions \$
Food & Beverages	Food & Beverages	112
Food & Beverages	Agriculture	82
Textiles and Wearing Apparel	Textiles and Wearing Apparel	325
Petroleum, Chemical and Non-Metallic Mineral Products	Petroleum, Chemical and Non-Metallic Mineral Products	90
Electricity, Gas and Water	Petroleum, Chemical and Non-Metallic Mineral Products	151
Construction	Petroleum, Chemical and Non-Metallic Mineral Products	195
Construction	Metal Products	131
Transport	Petroleum, Chemical and Non-Metallic Mineral Products	248
Transport	Financial Intermediation and Business Activities	81
Financial Intermediation and Business Activities	Financial Intermediation and Business Activities	250
Household final consumption	Food & Beverages	286
Household final consumption	Petroleum, Chemical and Non-Metallic Mineral Products	155
Household final consumption	Electrical and Machinery	86
Household final consumption	Transport Equipment	89
Gross fixed capital formation*	Electrical and Machinery	320
Gross fixed capital formation*	Transport Equipment	96

*Household + Government + Non Profit Institutions + Businesses

Main international exchange knots; Source: Estimates by Utopies on the basis of the agency's 2015 Input-Output model

This analysis identifies the following 4 features of Mauritius' economy as the main sources of the island's strong dependence upon foreign imports:

- The high dependence of Mauritian households on two categories of imported products in particular: Petroleum, chemical and non-metallic mineral products (4% of annual Mauritian household consumption is dedicated to this kind of imported good) and Food and Beverages (6,5%)
- **International intra-sector exchanges:** The Textile, Financial intermediation and Business Activities and Food and Beverages sectors source a significant amount of purchases abroad within their own sector.
- The importance of Petroleum, Chemical and Non-Metallic Mineral imports for the **daily activities of 3 key industries on the island** (Transport, Construction and Electricity, gas, water).
- The heavy dependence of Mauritian households, companies and public sector on **machines and transport equipment**.

Mauritius tends to import more than other islands

Imports make up 59% of Mauritius' GDP, above the average import ratio of "Small Island Development States (SIDS)" (54%), though the average ratio for Pacific islands stands at 67%. Mauritius' import ratio is also higher than both the average import ratio for high-income countries (30%) and the world average (28%).

Mauritius boasts more industry than most SIDS countries, hence it has different import needs than other insular economies which are mostly built on tourism and finance. **Still, to establish a new kind of prosperity and make Mauritius more resilient than other SIDS countries, Mauritius will have to find new and better ways of anchoring the island's industrial production within its local economic fabric.**

Imports of goods and services (% of GDP) 2015

World Bank national account and OECD National Accounts data files.

Singapore	152	Fiji	56	New Caledonia	37
Malte	132	Saint Vincent and Grenadinesa	54	Madagascar	36
Seychelles	104	Guam	54	Papua New Guinea	32
Nauru	102	Salomon Islands	53	Dominican Republic	29
Îles Marshall	91	Haiti	51	Bermudes	29
Micronésie, États fédérés de	77	Antigua and Barbuda	49	Sri Lanka	29
Palaos	71	Comores	47	French Polynesia	28
Maldives	69	Jamaica	46	New Zealand	27
Mariannes	68	Islande	46	Trinidad and Tobago	26
Chypre	64	Barbade	44		
Cabo Verde	59	Porto Rico	42		
Saint-Kitts-et-Nevis	59	Virgin Islands	41		
Mauritius	59	Vanuatu	40		
Dominique	59	Bahamas	39		

Imports of goods and services (% of GDP) 2015

World Bank national account and OECD National Accounts data files.

Mauritius	59
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Source: calculations made on the basis of the Input-Output 2015 model reconstructed by Utopies

1.2.2 Mauritius' exports do not sufficiently benefit the island's economy

The decline of Mauritius' local multiplier cannot be attributed entirely to leakages associated with the island's imports.

The limited capacity of certain of Mauritius' exports to stimulate the rest of the country's economy raises the following question: to what extent are the island's exports actually « Made in Mauritius »?

By international convention, at least **50% of a product's added value must be acquired in a given country⁴** to receive the « Made in » label. What is the case for products exported by Mauritius? Out of 38 of the island's exporting productive sectors (agricultural or manufacturing), 31 can be labelled « Made in Mauritius » while only 7 do not achieve the necessary 50% threshold. One of these however is the textile sector, which constitutes the island's main source of exports (49%).

% of Domestic Value Added – Mauritius

LESS THAN 50%

Textile articles other than apparel
Forestry and logging products
Knitted or crocheted fabrics; wearing apparel
Crude petroleum and natural gas
Metal ores
Yarn and thread; woven and tufted textile fabrics
Wastes or scraps

50 TO 70%

Medical appliances, and optical instruments, watches and clocks
Special purpose machinery
Transport equipment
Meat, fish, fruit, vegetables, oils and fats
Electrical machinery and apparatus
Furniture; other transportable goods n.e.c.
Rubber and plastics products
Tobacco products
Grain mill products, starches and starch products
Beverages
Dairy products
General purpose machinery
Other chemical products; man-made fibres
Basic chemicals
Fabricated metal products, except machinery and equipment
Radio, television and communication equipment and apparatus
Leather and leather products; footwear
Other minerals
Products of wood, cork, straw and plaiting materials
Basic metals
Coke oven products; refined petroleum products; nuclear fuel
Coal and lignite; peat
Office, accounting and computing machinery

MORE THAN 70%

Sugar Cane
Products of agriculture, horticulture and market gardening
Sugar
Fish and other fishing products
Stone, sand and clay
Glass and glass products and other non-metallic products
Live animals and animal products
Pulp, paper and paper products; printed matter

SOURCE : FMI, 2017

Source : Estimates by Utopies based on data from UNCTAD-Eora Global Value Chain

⁴ Domestic Added Value: to produce a good it is often necessary to activate a global value chain with different added value created at different steps of production located in different countries. Domestic Added Value gauges the proportion of added value acquired in the exporting country..

In 2015 alone, **Mauritius secured a mere 60% of the overall added value derived from its exported goods.** It must be noted that very few industries exceed a rate of 70%, though Mauritius' Sugar industry scores an excellent 84%, being particularly well anchored locally.

A number of exports (such as textiles or fishing) clearly generate wealth for Mauritius, however their lack of complexity limits their:

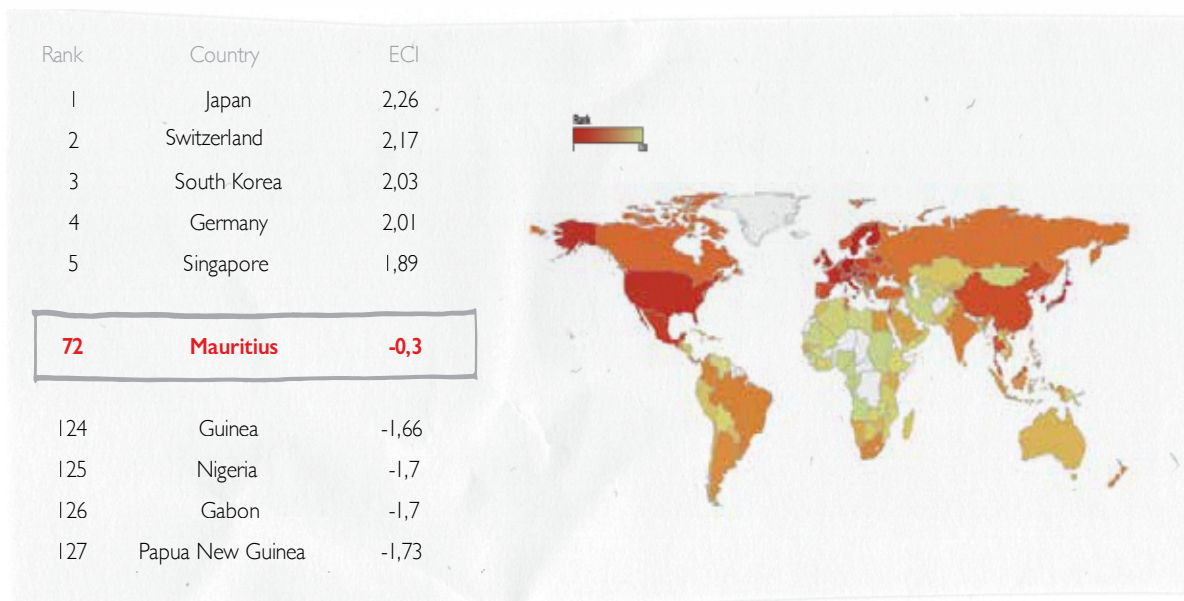
- Direct impacts (unitary value of exported products)
- Indirect impacts: these exported products don't activate a dense and diverse chain of local suppliers and often don't create the product's main added value in the country.

A study conducted by the Harvard Center for International Development since 2011 assesses a country's level of economic complexity (Economic Complexity Index, ECI) based on the level of complexity of exported products (Product Complexity Index, PCI).

What is the complexity index?

Prosperous countries possess «productive knowledge». The Economic Complexity Index (ECI) measures the range of products a country is capable of producing thanks to productive knowledge accumulated by the country's people and their interactions in increasingly complex networks. The idea behind this index is that a country's productive knowledge is revealed by a country's exports. Hence, a country's economic complexity index is measured on the basis of the following two criteria: diversity of exports (a country featuring a diverse wealth of knowledge is able to produce a wider range of products and therefore increase the diversity of its exports) and ubiquity of exported products (complex goods are less common, reducing their ubiquity as they are only produced in a small number of complex economies).

Research by Harvard's CID demonstrates that a country's economic complexity significantly affects its prosperity (GDP) and the reduction of socio-economic inequalities (GINI index)⁵.



Complexity Index per Country; Source: Harvard Center for International Development

In 2016, Mauritius ranked 72nd out of 126 countries on the Economic Complexity Index (ECI) due to the low Product Complexity Index (PCI) of the island's food (sugar and fish products) and textile exports. Standing at a low in 1968 (ECI = -0,98), Mauritius' level of economic complexity rose continuously until 1988 when it began declining again to reach another low in 1998 (-0,63), increasing ever since to reach its current rate (-0,30) thanks to the recent economic diversification of the island's industries and exports.

	NET EXPORTS (MILLIONS \$)	PCI
Other men's or boys shirts of cotton	164	-2,317
White Sugar	152	-1,318
Men/boy trouser breech&short of cotton not knitted/crocheted	117	-2,172
T-shirts, singlets and other vests, of cotton, knitted or crocheted	117	-1,827
Non-industrial diamond worked, but not mounted or set	115	-2,508
T-shirt,singlet & other vest of other textile excl cotton,knitted/croche	79	-2,321
Tunas, skipjack and atlantic bonito, whole or in pieces but not minced in vegetable oils	74	-0,784
Other Cane Sugar	70	-2,349
Women/girl trouser,bib,short of cotton,not knit/crocheted	38	-2,461
Jerseys, pullovers, cardigan,waist-coat etc of cotton,knitted/crocheted	29	-2,382
Chains and similar articles>200 cm of other precious metal	24	0,655
Men's or boys' shirts of cotton, knitted or crocheted	21	-2,172
Other ,whether or not as parts of ensembles	21	-1,428
Printed books, brochures, leaflets etc excl 490110-991	20	0,128
Live Primates	19	-1,638

Product Complexity Index (PCI) of Mauritius' main exports

⁵ Linking Economic Complexity, Institutions and Income Inequality, by D. Hartmann, M.R. Guevara, C. Jara-Figueroa, M.Aristarán, C.A. Hidalgo.

AJG Simoes, CA Hidalgo. The Economic Complexity Observatory: An Analytical Tool for Understanding the Dynamics of Economic Development. Workshops at the Twenty-Fifth AAAI Conference on Artificial Intelligence. (2011)

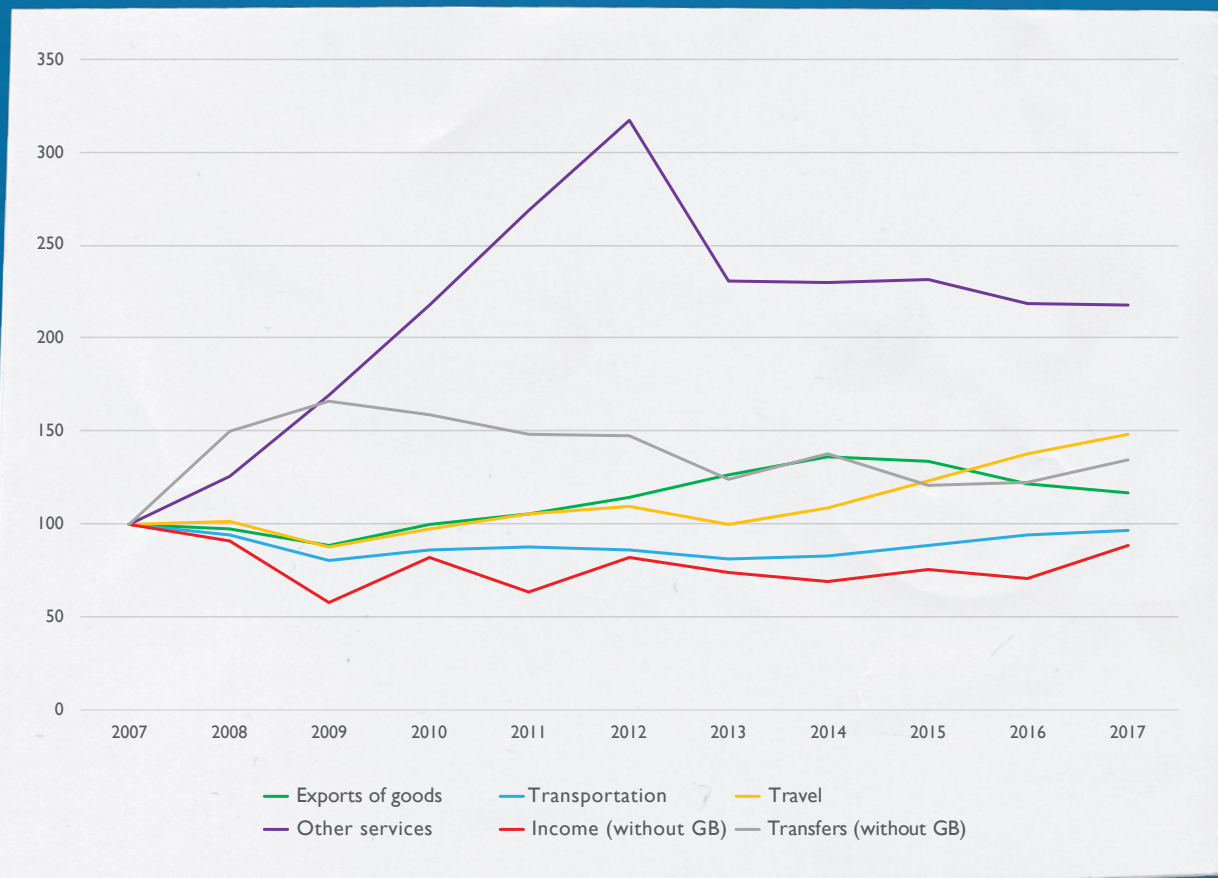
1.3 What are the immediate consequences of a declining local multiplier effect?

The local multiplier effect's drop has economic, social and environmental consequences.

1.3.1 An economic model which lacks visibility at a time when a number of the island's assets to attract international income may be eroding

These last 20 years, the growth of Mauritius' national income has relied on a significant rise in international income, which partly offset the drop of the island's local multiplier.

Evolution of external flows over the last 10 years



Source: Mauritius Stats

However, this rise in international income seems increasingly unstable these last 10 years as it appears some of the island's assets to attract international wealth may be running out of steam: as seen in the graph above, exports seem to be leveling off while income and transfers vary from one year to the next, transport services have entered a smooth-trend line and other service activities (offshoring) are stabilizing after a decade of strong decline. The tourism industry alone stands out with a sharp upward progression.

The possibility of a sustained decline of the multiplier effect coupled with a weakening of certain sources of international income reduces the predictability of Mauritius' growth for years to come.

1.3.2 Curtailed economic self-reliance

Economic self-reliance has long been a central concern for most islands due to the specificities of insular economies (small land surfaces, remoteness/isolation, vulnerability), in particular for islands which have acquired political independence. Where does Mauritius stand when it comes to economic self-reliance?

The multiplier effect, which is defined and explained in the previous sections of this report, is an interesting indicator when it comes to understanding an island's self-reliance. Indeed, an island's economic self-reliance cannot be estimated by simply analyzing products purchased by households in the island's shops. **Mauritius' « true » economic self-reliance must be measured against the island's capacity to produce the full range of products (raw materials, finished products and final transformed products) which enter the composition of any household good consumed on the island.**

For instance, take the case of a meat and pasta ready meal sold in one of Mauritius' supermarkets. Beyond the island's capacity to produce the ready meal itself, Mauritius' economic self-reliance must be assessed taking into account the island's capacity to produce pasta, transform meat, produce various food ingredients, raise cattle (and feed it), grow wheat (with seeds and fertilizer), produce eggs and other inputs such as packaging (and its metal, cardboard or plastic components) as well as agriculture/food processing machines required for the production of such a ready meal.

Multiplier effect analysis allows to measure the percentage of Mauritian production for any household good at every step of the production process (« from field to plate »). In this study, economic self-reliance is measured by analyzing Mauritian household food consumption (food retail purchases and restaurants).

In 2015, Mauritius' economic self-reliance was estimated at 34%: satisfying Mauritian household demand required a total of 4,347 USD per capita from

agricultural, extractive and manufacturing industries (taking into account production of every component of consumed goods, excluding services, based on “producer” prices not including commercial margins). About a third of this production was located in Mauritius (i.e. 1,461 USD per resident).

In 2015, 54% of agricultural products consumed by Mauritians (whether raw, processed or cooked in a restaurant) came from a local farm or field. Mauritius’ agricultural self-reliance has decreased sharply since 1995 (-7,5 points). Mauritius’ food industry also registered a decrease in self-reliance (-4,6) and tends to be less and less present in the value chain of food products consumed on the island (final transformation or food ingredients). Despite Mauritius’ strong specialization in the textile industry, the island’s autonomy when it comes to fashion is also on the decline (-3,6). As for heavy industry production – metal, chemicals, petroleum, electrical and mechanical products – the island’s self-reliance hovers under 10%.

SELF-RELIANCE 2015				
	% Mauritius	Mauritius \$	Total \$	Evol 2015 / 1995
		<i>per capita</i>		
Agriculture	54%	\$264	\$488	▼ -7,5
Fishing	10%	\$15	\$154	— -0,3
Mining and Quarrying	12%	\$4	\$30	▼ -1,6
Food & Beverages	58%	\$778	\$1 352	▼ -4,6
Textiles and Wearing Apparel	41%	\$169	\$415	▼ -3,6
Wood and Paper	33%	\$37	\$112	▼ -1,0
Petroleum, Chemical and Non-Metallic Mineral Products	8%	\$96	\$1 252	— -0,6
Metal Products	9%	\$13	\$140	— -0,2
Electrical and Machinery	6%	\$10	\$168	— 0,2
Transport Equipment	11%	\$14	\$120	— -0,8
Other Manufacturing	53%	\$62	\$118	▲ 3,0
Total	34%	\$ 1 461	\$ 4 347	-3

Mauritius economic self-reliance for various sectors. Source: Estimates by Utopies

1.3.3 Persisting social inequalities despite strong growth of income and international wealth attraction

In Mauritius, both the average and median level of disposable income per household have significantly increased over the last 10 years:

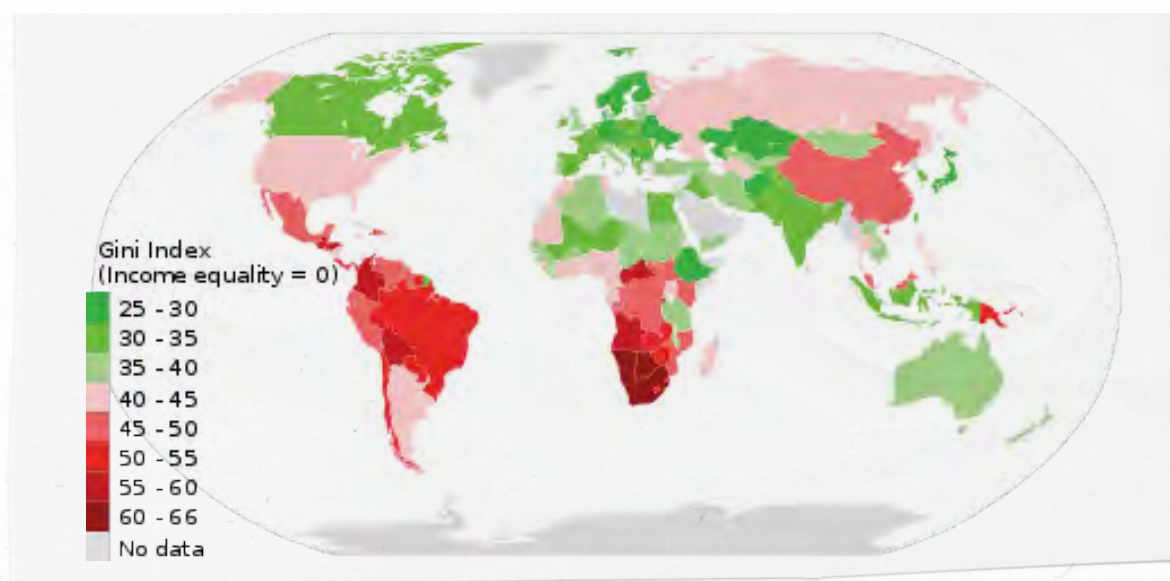
- Average income: +92% (36,810 Rs in 2017 vs 19,080 Rs in 2007)
- Median income: +93% (28,250 Rs in 2017 vs 14,640 Rs in 2007)

However, over the same period Mauritius' Gini coefficient, which measures the degree of inequality in the income distribution of households, has remained stable; while it had dropped halfway through the decade, it has now bounced back to its previous levels.

	1975	1980/81	1986/87	1991/92	1996/97	2001/02	2006/07	2012	2017
GINI COEFFICIENT	0.420	0.445	0.396	0.379	0.387	0.371	0.388	0.414	0.4

Note: Gini Coefficient measures the degree of inequality in the income distribution of households. It varies between 0 for complete equality and 1 for complete inequality

Mauritius is now positioned in group n°4 (Gini coefficient = 40-45), considered “moderately high”.



Countries' income inequality according to their most recent reported Gini coefficient values (often 10+ years old) as of 2014: red = high, green = low inequality

While overall levels of income are increasing significantly, the distribution of this income within the island's population remains unequal. Mauritius' economic growth model is insufficiently inclusive (able to extract people from poverty).

1.3.4 CO2 Omissions: Mauritius' economy is increasingly carbon-based (though it may not be visible locally)

Following the COP21 in 2015, Mauritius made a commitment to reduce its greenhouse gas emissions (GHG) alongside 189 countries. Mauritius committed to a 30% reduction of the island's emissions by 2030, a commitment which concerns emissions which are physically produced on the island using Production-based accounting (PBA), in accordance with the UN's GHG reporting standard. However, this reporting standard does not account for the country's entire environmental footprint since GHGs are estimated on the basis of what is produced on the island, not taking into account what is consumed. Indeed, Mauritius' actual carbon footprint includes its territorial emissions (direct emissions from local households and companies) as well as GHGs generated by the production and transportation of imported goods, while excluding territorial emissions associated with locally produced goods which are exported.

This is what is called Consumption-based accounting (CBA), which takes into account emissions connected with Mauritius' consumption. For instance, Mauritius' PBA includes the textile industry's emissions (though garments produced are mostly exported) while its CBA takes into account emissions connected with the production and transportation of clothes imported by Mauritians.

In 2015, the gap between Mauritius' CBA and PBA carbon footprint stood at 117% (up from 84% in 2005). **Between 1970 and 2015, Mauritius' CBA carbon footprint rose a stark 900%**, reaching a current 5,6 tons per resident per year, which is still lower than most insular economies. However, this ratio is strongly correlated with both quality of life and the level of sophistication of imported products (capital goods in particular). Since 1970, for every 1% rise in GDP the island's CBA carbon footprint rose 0.93% on average.

Considering the island's goal to increase its GDP in the coming years, how much will the country's carbon footprint rise by 2025? How can this footprint be sequestered? In particular, how can import-related emissions be reduced to avoid outsourcing environmental impacts associated with the island's household consumption to the rest of the world⁶?

⁶Approximately 30 % of threats to wildlife species are connected to international trade – a proportion which in some cases can reach 60% in countries such as Papua New Guinea or Sri Lanka.

THE DROP IN THE LOCAL MULTIPLIER EFFECT ACCOUNTS FOR THE STARK RISE IN THE ISLAND'S CARBON FOOTPRINT

Mauritius' "CO₂ omissions":

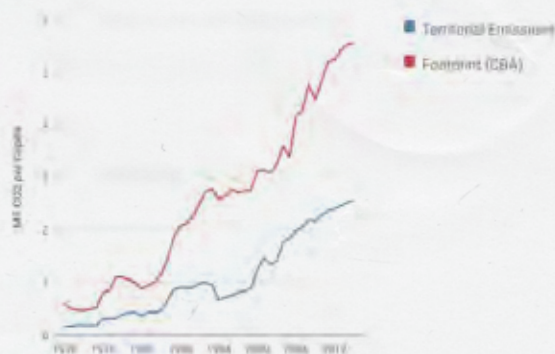
Decarbonizing production as well as consumption

117%

of carbon omissions in 2015
up from 84% in 2005

(the gap between GHG emissions produced in Mauritius and emissions associated with the production of products and services consumed on the island, including imports.)

Per Capita Carbon Footprint for Mauritius (1970-2015)



Carbon Footprint on Consumption-based accounting (CBA) - 2015

Hong Kong	51,2	Malta	6,6
Singapore	28,8	Mauritius	5,6
Bermuda	24,3	Maldives	4,4
British Virgin Islands	18,5	Jamaica	4,1
Bahamas	14,1	Cuba	3,4
Iceland	13,0	Dominican Republic	2,7
Cayman Islands	13,0	Fiji	2,4
Aruba	10,1	Samoa	1,5
Seychelles	10,0	Vanuatu	1,3
New Caledonia	9,4	Sao Tome and Principe	1,1
Cyprus	9,3	Cape Verde	1,1
Trinidad and Tobago	9,1	Sri Lanka	1,0
New Zealand	8,5	Papua New Guinea	0,7
Antigua	8,0	Haiti	0,3
Barbados	7,6	Madagascar	0,2
French Polynesia	7,1		

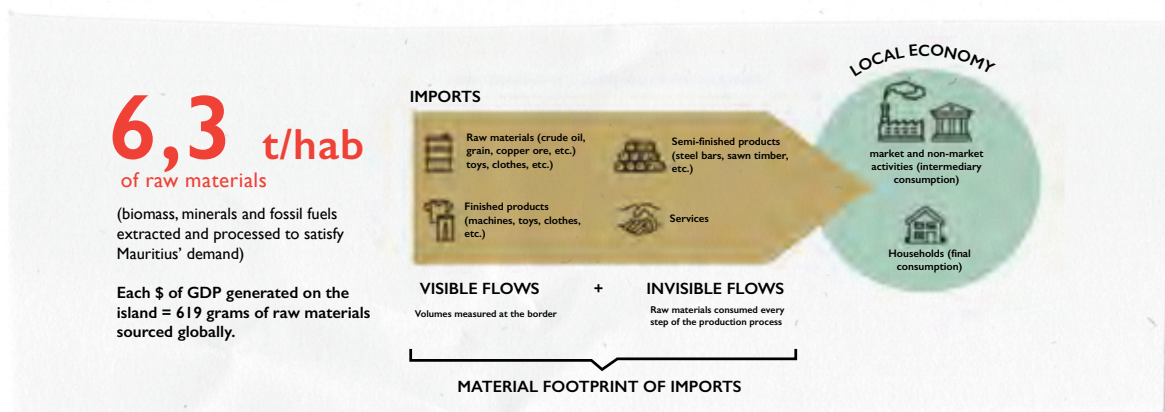
Carbon footprint of Mauritius consumption

1.3.5 Increasing vulnerability and dependence on imported raw materials

Each imported good includes « hidden » raw materials (biomass, (non)metallic minerals, fossil fuels...) that cannot be seen but have indeed been extracted and processed to manufacture and transport the good to Mauritius, every step of the production chain.

In 2015, over 7,9 million tons of raw materials were used worldwide to satisfy Mauritian demand (companies, households, government), i.e. 6,3 tons per inhabitant. For every USD of GDP generated on the island, 619 grams of raw materials must be sourced globally.

This dependence on international raw materials exposes the country to a number of risks related to resource rarefaction (in particular fossil fuels, but also mineral resources), climate change as well as geo-political and socio-economic risks (exposure to price volatility).



Vulnerability and dependence of Mauritius' economy to imported raw materials

RAW MATERIALS INPUTS - IMPORTS MAURITIUS 2015

	Total	Per inhabitant
Raw material inputs, total biomass (t)	730 991	0,58
Raw material inputs, total ores (t)	1 198 997	0,95
Raw material inputs, total construction material (t)	3 945 671	3,12
Raw material inputs, total fossil fuel (t)	2 047 194	1,62
	7 922 853	6,26

Raw materials extracted worldwide for each USD of Mauritius' GDP (in grams)

Papua New Guinea	4 177	Samoa	718
Madagascar	3 620	Cyprus	716
Hong Kong	2 600	Mauritius	619
Sao Tome and Principe	1 906	Bahamas	528
Trinidad and Tobago	1 618	Malta	476
Vanuatu	1 234	Jamaica	413
Seychelles	1 138	Iceland	400
Maldives	1 075	Haiti	381
Fiji	966	Dominican Republic	338
Antigua	915	New Zealand	331
Singapore	836	Sri Lanka	322
Cape Verde	772	Barbados	307

Sources: Estimates by Utopies based on the agency's 2015 Input-Output model and EORA data (worldmrio.com)

1.4. Which strategy should Mauritius pursue to durably become a high-income country?

Mauritius must now find a development strategy that enables the island to durably gain entry to the club of high-income countries while maximizing the island's positive social and environmental externalities.

How can international income and the local multiplier be combined to effectively achieve this goal in the coming years?

A preliminary analysis of the trajectories of existing (very) high-income countries can help shed some light on this complex equation.

1.4.1 Which model should Mauritius adopt to durably become a high-income country?

3 models would allow Mauritius to durably gain entry to the club of high-income countries.

1.4.1.1 Model 1: Countries with near-maximum local multipliers

Attaining a near-maximum local multiplier (> 6) alongside high external income (4,000 to 6,000 USD/capita). Only 3 high-income countries (Australia, Japan and the USA) have succeeded in achieving this model by featuring diversified economies (with dense industrial fabrics), high levels of private and public debt and much lower import ratios than average (15-20% of GDP while imports account for 30% of GDP in high-income countries and 50% in small countries).

Year 2015	National income per capita	International income per capita	Multiplier
USA	\$52 833	\$ 5 931	8,91
Australia	\$50 150	\$ 6 227	8,05
Japon	\$33 713	\$ 4 474	7,53

Source: Estimates by Utopies based on World Bank, IMF and national statistics

1.4.1.2 Model 2: Countries with maximal external income

Maximizing external income (>10,000 USD/capita) without achieving a strong local multiplier (<2,5). Such is the case of oil producing countries, countries where financial services account for a strong proportion of national GDP, countries with export-oriented economies as well as autonomous territories which depend heavily on public subsidies. Such economies achieve high income (>15,000 USD/capita) with a lower local multiplier than Mauritius, however their external income is 5 to 10 times higher.

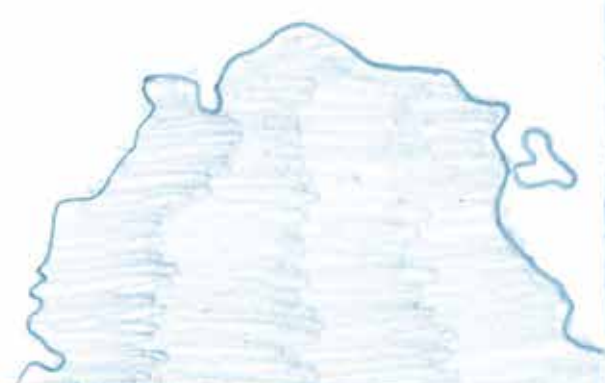
Year 2015	National income per capita	International income per capita	Multiplier
Luxembourg	\$82 697	\$113 964	0,73
Switzerland	\$71 448	\$33 078	2,16
Norway	\$62 183	\$25 057	2,48
Irlande	\$51 650	\$41 370	1,25
Hong Kong	\$37 029	\$42 194	0,88
Holland	\$36 237	\$15 407	2,35
Belgium	\$32 527	\$13 274	2,45
Kuwait	\$31 036	\$14 195	2,19

Source: Estimates by Utopies based on World Bank, IMF and national statistics

1.4.1.3 Model 3: Countries which balance external income and local multiplier

This third model is a hybrid, more balanced approach aiming for a high local multiplier (between 3,5 and 5,5) as well as high but accessible external income. A number of countries which have achieved high income feature external income that is comparable to that of Mauritius but boast a much higher local multiplier (Uruguay or Chile for instance).

With external income of little more than 4,000USD/capita (37% more than Mauritius) and a strong multiplier (3,76), Portugal now boasts income above the threshold of 15,000 USD/capita.

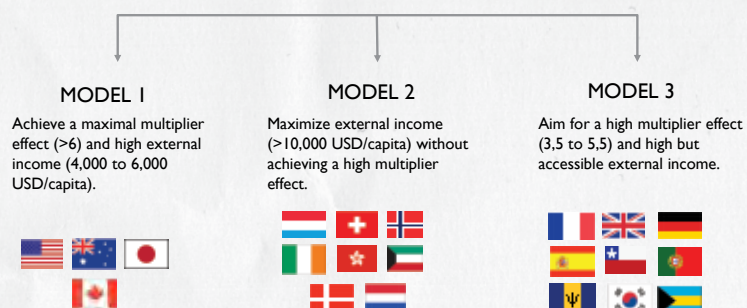


Year 2015	National income per capita	International income per capita	Multiplier
Canada	\$38 331	\$6 948	5,52
United Kingdom	\$35 572	\$8 344	4,26
Germany	\$35 640	\$9 372	3,80
France	\$30 915	\$6 843	4,52
Italy	\$26 068	\$4 215	6,18
Espagne	\$22 140	\$4 559	4,86
South Korea	\$24 291	\$5 483	4,43
Portugal	\$15 476	\$4 128	3,75
Greece	\$15 350	\$2 868	5,35
Uruguay	\$12 772	\$2 393	5,34
Chile	\$11 717	\$2 221	5,27

Source: Estimates by Utopies based on World Bank, IMF and national statistics

High-income countries: 3 trajectories combining international income and local multiplier effect

$$\text{LOCAL INCOME} = \text{EXTERNAL INCOME} \times \text{MULTIPLIER EFFECT}$$



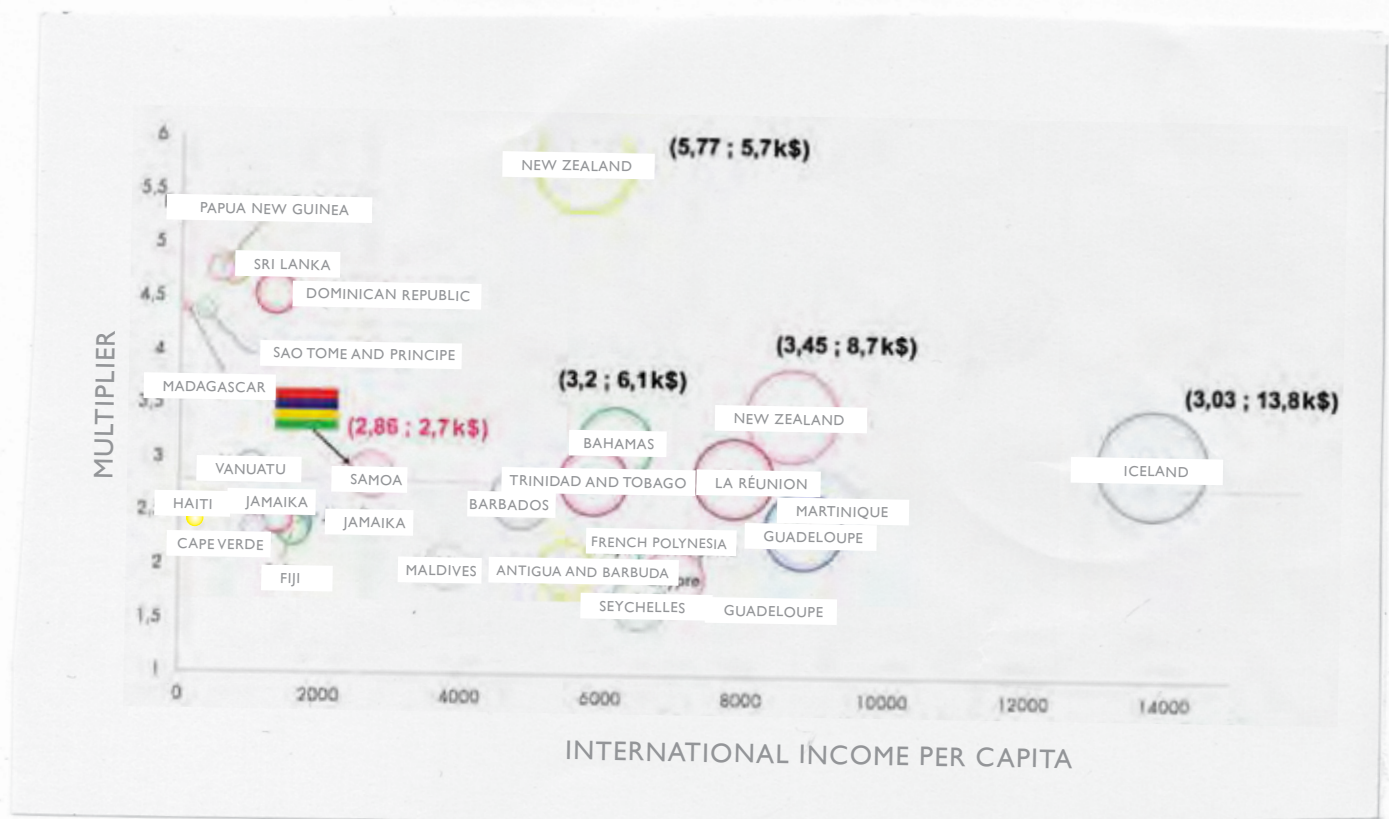
1.4.2 Which trajectory should Mauritius pursue to become a high-income country?

Assuming that Mauritius maintains stable growth of its GDP - around 3 to 4% - while maintaining its local multiplier at its current rate, the island could most likely double its per capita income by 2030-2035 (depending on the growth scenario considered).

However, considering the risk that the island's recent economic growth may not be sustained, if Mauritius wants to insure the island's future prosperity it must proactively increase its income and work to guarantee its durability, which would require that the country pursue a different trajectory.

In comparison with other island economies, **Mauritius operates at a median point between existing insular models, hence there are many possible directions Mauritius can explore to strike a more prosperous balance between international income and the local multiplier.**

Which trajectory would allow the island to successfully meet its economic, environmental and social challenges while also achieving its global ambitions?



Graph: Comparison of insular income models; Source: Utopies

Focus on other island economies

Today, the vast majority of island economies with middle to high incomes (see table below) have embraced model no. 2 – sometimes by emphasizing their uniqueness – in order to position themselves favorably within the globalized economy, featuring (very) large external income and a rather low local multiplier. Nevertheless, a few of their trajectories are noteworthy.

Firstly, New Caledonia owes its high prosperity not only to exported natural resources, but also to the island's vibrant local economic circuit (multiplier of 3,45) and a number of industrial sectors that are deeply embedded within the local economy (88% of the added value of exports remains on the island).

Iceland performs significantly better than average among other countries with a very high level of international income. Indeed, with almost 13,800 USD of international income/capita – placing it 14th in the rankings – Iceland has a multiplier of 3,03, compared with an average of 2,08 for the Top 15 countries.

Year 2015	National income per capita	International income per capita	Multiplier
Bermuda	\$77 741	\$39 218	1,98
Iceland	\$41 774	\$13 797	3,03
Singapore	\$40 936	\$37 554	1,09
New Zealand	\$32 836	\$5 691	5,77
New Caledonia	\$29 934	\$8 672	3,45
Martinique	\$23 199	\$9 115	2,55
Réunion	\$22 509	\$7 858	2,86
Guadeloupe	\$21 070	\$8 853	2,38
Bahamas	\$19 485	\$6 166	3,16
Malte	\$18 289	\$19 645	0,93
Trinidad et Tobago	\$16 537	\$5 861	2,82
French Polynesiae	\$14 267	\$6 965	2,05
Cyprus	\$13 402	\$7 016	1,91
Barbados	\$12 764	\$4 832	2,64
Seychelles	\$11 104	\$6 534	1,70
Antigua and Barbuda	\$10 939	\$5 502	1,99
Mauritius	\$7 731	\$2 703	2,86
The Maldives	\$7 637	\$3 796	2,01
Dominican Republic	\$6 057	\$1 334	4,54
Jamaica	\$3 905	\$1 636	2,39
Fiji	\$3 766	\$1 612	2,34
Sri Lanka	\$3 465	\$727	4,77
Samoa	\$3 389	\$1 384	2,45
Vanuatu	\$2 924	\$993	2,94
Papua New Guinea	\$2 616	\$548	4,77
Cape Verde	\$2 484	\$1 053	2,36
Sao Tome and Principe	\$1 508	\$345	4,38
Haiti	\$790	\$309	2,56
Madagascar	\$354	\$81	4,40

Source: Estimates by Utopies based on World Bank, IMF and national statistics

The Bahamas are heavily dependent on Travel & Tourism activities (the archipelago is the world's 9th most important tourist destination in terms of % of GDP) yet feature an advantageous multiplier for an island economy (3,16), having built a tourism industry with high local impact (hotel investments, a dense chain of suppliers of services and manufactured goods consumed by hotels and restaurants, public spending with effective VAT...).

Finally, although it is 100 times the size of Mauritius, New Zealand is undoubtedly the island economy that features the most successful combination of international income and local multiplier (5,77), although high private debt and environmental pressures are currently undermining this model.

A good multiplier effect should be neither too low nor too high

The local multiplier effect is highly variable from country to country, ranging from a minimum of 0,73 in Luxembourg to a maximum of 13,92 in Brazil. The local multiplier effect increases when:

- A country is able to limit imports of goods and services
- The added value of exports is generated primarily within the country
- The balance of income (labour, capital, transfers received – paid abroad) is positive (excluding offshore flows)
- Profits and income saved (not consumed) are re-invested in the country

These 4 points sum up the challenges of maintaining a prosperous and well-integrated economy in a globalized world, which requires maintaining competitiveness at the international level by manufacturing products with a high added value, limiting imports without resorting to protectionism with commercial partners (high-multiplier countries are often among the most protectionist) and being able to attract international income (particularly through direct investment abroad) while also fostering 'locavesting'.

Other mechanisms which enhance the local multiplier effect:

-private credit (household, companies) and/or public credit (state), particularly on international financial markets. Private credit fluidifies the economy and enhances the ripple effect of international income injected into a country's economy, allowing for spending to exceed income generated within the production cycle. However, it is necessary to remain within the limits of national savings capacities, and to take into account that interest on debt and the risk of high interest rates expose a country's economy to the risk of a financial shock.

-the informal economy, i.e. the production of households for other households, is primarily based on "individual incomes" which are not saved or taxed, and are largely re-spent within a country's economy (meaning less materials, equipment and services are imported).

1.4.2.1 What if Mauritius focused its efforts on maximizing the island's local multiplier effect?

Considering the size of Mauritius and the fact it is an island, the pursuit of an economic model based on a high local multiplier effect must be discarded. Indeed, not only does Mauritius feature limited natural resources, the island's economic circuit is not dense or diversified enough, nor sufficiently productive to achieve such a model.

It is also worth noting that the handful of countries which do have a high local multiplier effect have levels of private debt (close to 200%) that are three times higher than the current level of debt in Mauritius (where private credit plays an important role in economic growth, despite the risks of default).

1.4.2.2 What if Mauritius focused solely on increasing external income?

In this scenario, taking into account the downward trend in the island's local multiplier effect, Mauritius would need to double its external income to reach approximately 7Bn USD.

Is Mauritius capable of doubling industrial exports, tourism flows and financial activities (Global Business) in the next few years? Does the island display sufficient resources and innovation to achieve such a goal? What would be the social, environmental and organizational impacts of such a momentous shift?

Firstly, this would require a major transformation of the island's economic model to enable a strong increase in import volumes while also sharply increasing the unitary value of exported products. Above all, it would mean finding new niches within the globalized economy, since many economic levers which islands have relied on to generate income are weakening:

- Limited natural resources, in contrast to the deposits of oil/natural gas in Trinidad and Tobago, or nickel mining in New Caledonia
- Limited land, technical and human resources (which threaten Mauritius' ability to increase its volume of exports or the number of tourists the island can accommodate)
- Uncertainty and volatility in the Offshoring sector.

Nor does Mauritius benefit from public subsidies such as those received by so-called "ultra-marine" economies which are politically linked to European countries (islands which benefit from subsidies, e.g. those received by French islands which range from 2,000 to 5,500\$/capita).

This one-way approach seems incapable of generating a stark increase in income over the medium-term.

1.4.2.3 Which hybrid model is relevant to Mauritius?

A **hybrid scenario** aiming for a 50% increase of external income and a 25% increase of the island's local multiplier effect **would result in almost 5Bn USD of external income, i.e. nearly 4,000 USD/capita (compared with 2,700 USD/capita currently) and a local multiplier of 3,58 (currently 2,86).** In this scenario, Mauritius could reach the threshold of 15,000 USD of income per capita by 2025.

Increasing international income by 50% would not require a radical transformation of the island's frontline industries and would also allow for the gradual exploration of new high added-value niche industries such as new services associated with the digital revolution, financial technologies (fintech) and smart cities (greentech).

At the same time, having an enhanced local multiplier would lead to a more inclusive distribution of wealth in Mauritius, for example through the emergence of small artisanal, agricultural, industrial and energy production units on the island, creating space for Mauritians to prosper on their own means rather than rely on the stream of external flows.

Finally, this two-pronged approach (external income x local multiplier effect) leaves the island less exposed to external vulnerability, addressing "prosperity" in the broadest sense, including social and environmental issues.

	CURRENT GROWTH TREND	BOOSTING INTERNATIONAL INCOME	HYBRID MODEL
ESTIMATED GROWTH RATE	3 - 4 %	> 4 - 5%	> 4 - 5%
'HIGH INCOME COUNTRIES' OBJECTIVE	✓	✓ ✓ FASTER	✓ ✓
RELIABILITY OF ECONOMIC MODEL	?	?	✓
REDUCTION OF INEQUALITY	?	?	✓
RESILIENCE ECOLOGICAL SUSTAINABILITY	✗	✗	✓

Therefore, the challenge is as follows:

How can we boost international income per capita (+50% scenario) while enhancing the local multiplier effect (+25% scenario)?

1.4.3 Challenges and opportunities presented by a hybrid scenario

**« The pessimist sees difficulty in every opportunity.
The optimist sees the opportunity in every difficulty ».**

Winston Churchill

Pursuing this hybrid growth scenario implies challenging certain aspects of business as usual on the island in order for Mauritius to quickly and sustainably become a high-income country. We have seen that the current issue is not so much maximizing the multiplier effect as preserving it. How then can it be maintained and enhanced, and how can the value of external income be significantly increased (without necessarily massively increasing volumes) while also ensuring that these incomes remain on the island? Which clusters of exporters have high added value and strong local roots?

Furthermore, it should be recalled that increasing the island's income and standard of living will spur both household and government spending, as well as investments in non-basic goods which are often imported (capital goods, medication, cosmetics, luxury foods...), creating many opportunities for Mauritians to establish new businesses which provide local responses to fulfill these needs.

In the year 2015, the total value of imports to Mauritius (excluding services) stood at 4,53Bn USD⁷, representing a potential of 127,500 local jobs (based on average sectoral wages). If 10% of imports were replaced by Mauritian offers, 12,750 jobs would be created and Mauritius would achieve a so-called residual or frictional unemployment rate of less than 5% of the labour force.

⁷ Excluding re-exports – not destined for domestic demand – net imports of goods are now worth 3,75Bn USD



Imports of business services (accounting, management, taxation, legal services, IT, engineering, marketing and communications) may also in part be replaced at local level. Such imports represent nearly 727M USD, or a potential 10,000 to 12,000 jobs.

On the other hand, exports of services (excluding tourism) were worth nearly 744M USD in 2015 (just 24% less than exports of goods). Hence the development of Mauritius' exports of services is an important lever for the island's growth.

International trade in services is quickly catching up with exports of goods in many countries and is a new source of growth, particularly in emerging and developing countries. **According to a recent IMF study⁸, services, which account for 70% of global GDP and jobs, are also becoming an important part of international trade, accounting for 20% of global exports in 2014.**

This increase is not only due to increased exports of traditional services such as travel and transport, but also to modern technology-based services such as business services (including research and development, and consulting), computing and information services, financial services and intellectual property. In addition, the activities of manufacturing companies create some growth in services⁹. Therefore, we refer to the “servitization” of manufacturing industries, or hybridization of industries and services.

In addition to a favorable global environment, exports of services generally feature a stronger local anchoring of added value than manufactured goods. For Mauritius' economy, this report advocates diversifying the island's service exports beyond traditional service industries such as tourism, transport or even financial services.

⁸ Prakash Loungani, Saurabh Mishra, Chris Papageorgiou, and Ke Wang – World Trade in Services: Evidence from A New Dataset – IMF Working Papers, WP/17/77, March 2017

⁹ Fabrice Berthaud – Le commerce en valeur ajoutée (“Trade in Added Value”) -The French Ministry of Economy and Finance, Public Treasury Working Paper N° 2018/4, June 2018

1.4.4 Mauritius, an economy which benefits from enhancing its openness as well as its local anchoring

The issue here is not to advocate for protectionism, which in a globalized and reciprocal economy would be counterproductive. Rather than defend itself with tariff barriers, the island should find ways to stimulate new forms of local entrepreneurship and foster the emergence of new local industries. This is necessary in order to ensure Mauritius' inclusion in a globalized economy and guarantee sustainable growth for the island.

ULTRA LOCALISM	LOCAL ECONOMY
Self-sufficiency Maximum self-reliance	Reasonable reduction target (10 to 15%) – Rebalancing
Protectionism Defending existing offers « Re-localization »	Entrepreneurship – Development of new local offers - New local economic models
Conservatism – Patriotism	Innovation - Emancipation Renewed approach to globalization
Systematic replacement of foreign offers with local offers	Better local anchoring of the economy, and strengthening of exports
Degrowth	Prosperity and durability Internalizing externalities

Which goods have high import-substitution potential? Which goods have evolved the most between 2007 and 2015?

Agriculture & Fishing

Grain imports increased by 23% between 2007 and 2015, reaching a total of 111M USD and making this the 8th largest import category on the island.

Fisheries imports (of fish, crustaceans, and shellfish) have remained stable since 2007 (the 7th largest import category).

Although vegetable imports are less valuable (29M USD in 2015), they have increased sharply since 2007 (+43%).

Textiles and Wearing Apparel

Although cotton imports fell by 10% between 2007 and 2015, they are still worth 160M USD (the 6th largest import category on Mauritius). Imports of synthetic fibers, on the other hand, are up (+58%) to 33M USD.

Imports of clothing and footwear have both risen sharply since 2007 (+93% and +122% respectively). Together in 2015 they were worth 68M USD.

Food, beverages and tobacco

With a significant increase of +18M USD, in 2015 imports of dairy products rose to 90M USD, making dairy by far the number 1 food and beverage import category on the island. With a 63% increase, imports of processed meats were worth more than 53M USD in 2015 (the 2nd largest food import). Three import categories experienced three-digit growth; cereal preparations, flour, and pastry preparations (+142%), sugar and sugar confectionery (+114%), food industry waste and prepared animal feed (+146%).

Tobacco imports, including tobacco substitutes, have been on the rise since 2007 (+35M USD), with total imports of 49M USD (+244%).

Electrical and Machinery

Despite a 12% drop in imports since 2007, boilers, machinery, appliances and mechanical gear remain, at more than 280M USD, Mauritius' second largest import category.

Imports of electrical and electronic equipment (sound, image, and computing equipment) are steadily rising on the island (+22%), and with 212M USD of imports, were the fourth-largest import category in 2015.

Transport Equipment

With an increase of 63%, vehicles and vehicle parts now represent the third largest import category on the island (this category was 5th in 2007).

Petroleum, Chemical and Non-Metallic Mineral Products

The combustibles, fuel and bitumen/asphalt sector is easily the largest import category in Mauritius (680M USD) and is still growing (+37M USD since 2007).

Imports of plastics (+19%) and rubber (+38%) represent a total of nearly 134M USD (and are both the 8th largest import category).

Pharmaceuticals have experienced one of the largest increases since 2007 (+32 M USD, or total imports of nearly 88M USD in 2015).

Imports of cosmetics and perfumes have been increasing sharply since 2007 (+65%) and have now reached 50M USD.

Imports of stones, pearls and precious metals are up 57%, making this the island's 6th largest import category (up one place from 2007).

Wood and Paper

Imports of paper and cardboard are rising moderately (+8%, 55M USD), and in 2015 were the 14th-largest import category on the island.

Despite a 13% decline, imports of wood articles remain at a high level (35,7M USD).

Metal Products

Imports of iron and raw steel have dropped 18% since 2007, while imports of iron and steel articles (tubes, containers and rails) have risen by 38% (86M USD). Imports of wrought and raw aluminium have risen sharply (+66%).

Other Manufacturing

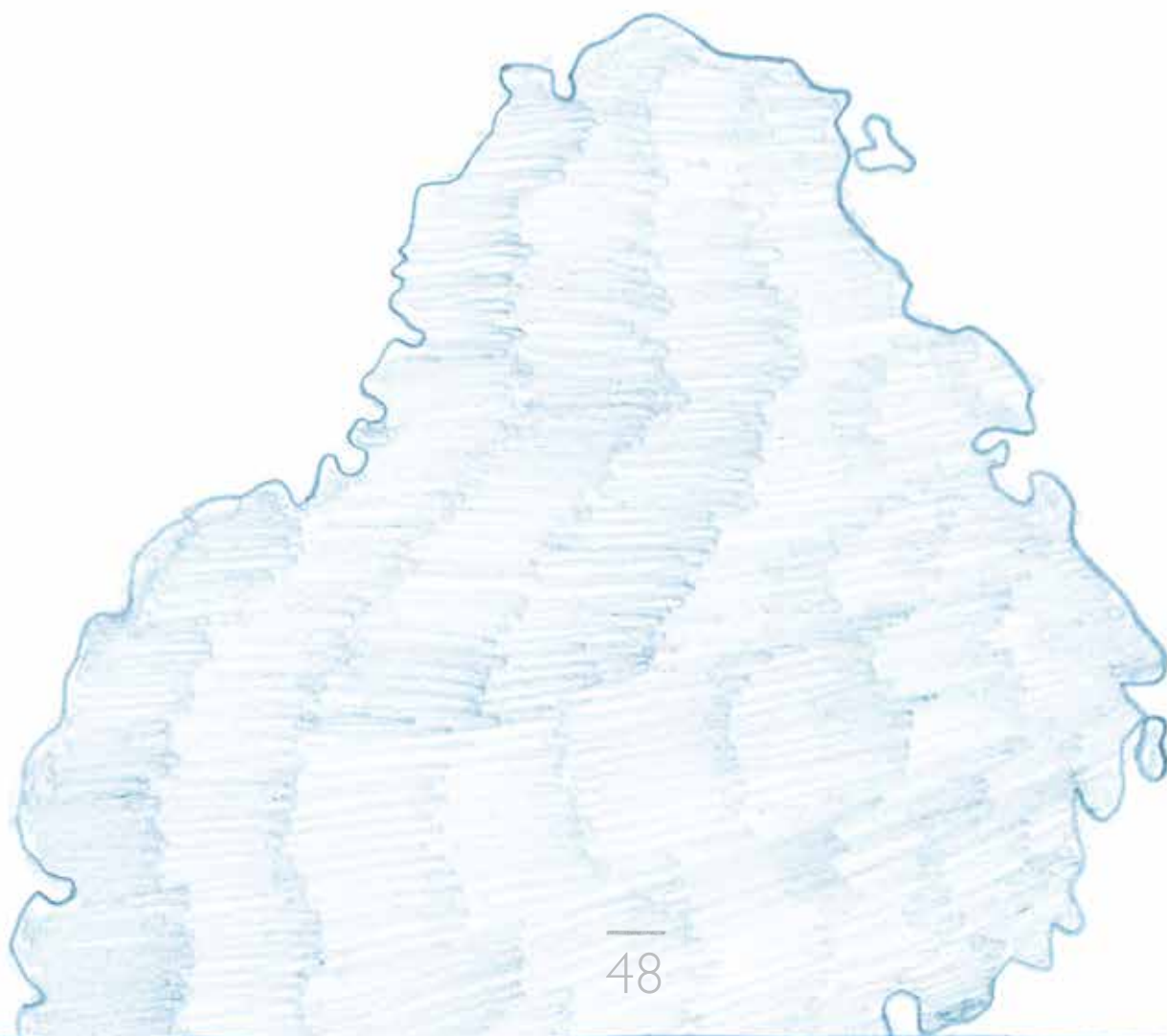
Since 2007, Mauritius has seen a jump in imports of manufactured goods: +50% for furniture, office furniture, bedding and lighting; +95% for small items of pharmaceutical equipment, stationery, sewing and DIY equipment.

CONCLUSION OF PART I

Prosperity on Mauritius is the product of both its international attractiveness and its ability to maximize the island's local multiplier effect, i.e. its capacity to sustainably circulate wealth within the country's economy. In order to increase the multiplier effect, imports should be reduced, and high added-value exports increased.

At the same time, in order to decarbonize Mauritius' economy and make it less vulnerable to climate change, less dependent on imported raw materials, and generally more self-reliant, the island must increase production from local inputs (natural, human, technical, and financial).

"Island entrepreneurship" based on local resources holds tremendous potential for entrepreneurs interested in local markets, provided they are able to offer innovative business models, by means of smaller, more circular, more "collaborative" and "inclusive" production solutions employing segments of local populations which are usually excluded.



PART 2

Fostering innovative and sustainable entrepreneurship in Mauritius

Three pillars can be explored to foster the emergence of new entrepreneurship models and opportunities on the island, three ways in which focusing on local manufacturing can lead to greater prosperity and sustainability.

Three pillars of local manufacturing

Local manufacturing allows to:	MAKER ISLAND	CIRCULAR ISLAND	SMART ISLAND
Reduce imports by producing locally what is no longer, not yet or insufficiently produced on the island	Adapt production means to the size of the local market (micro-manufacturing, micro-farming) using local resources	Replace imports with inputs produced locally from recycling, repairing or reuse	Replace the production of goods with service offers (service contracts) or sharing services (collaborative platforms)
Complexify exports and generate greater revenues from local knowledge and savoir-faire	Foster the emergence of a local production mindset focused on transmission and collaboration (incubators, third places)	Develop innovative savoir-faire to generate new local resources from waste (agricultural, industrial, household) or surpluses	Export immaterial value: fees, royalties, licenses, franchising
Reduce Mauritius' ecological and material footprint and increase the island's sustainability resilience and capacity to adapt to climate change	Develop The island's autonomy	Reduce « Product in - Trash out » (PITO) by creating local loops	Promote a new "Data in - Data out" immaterial wealth model



Making Mauritius a “maker island” means increasing its ability to produce what it consumes using local resources (human, material, technical, natural).

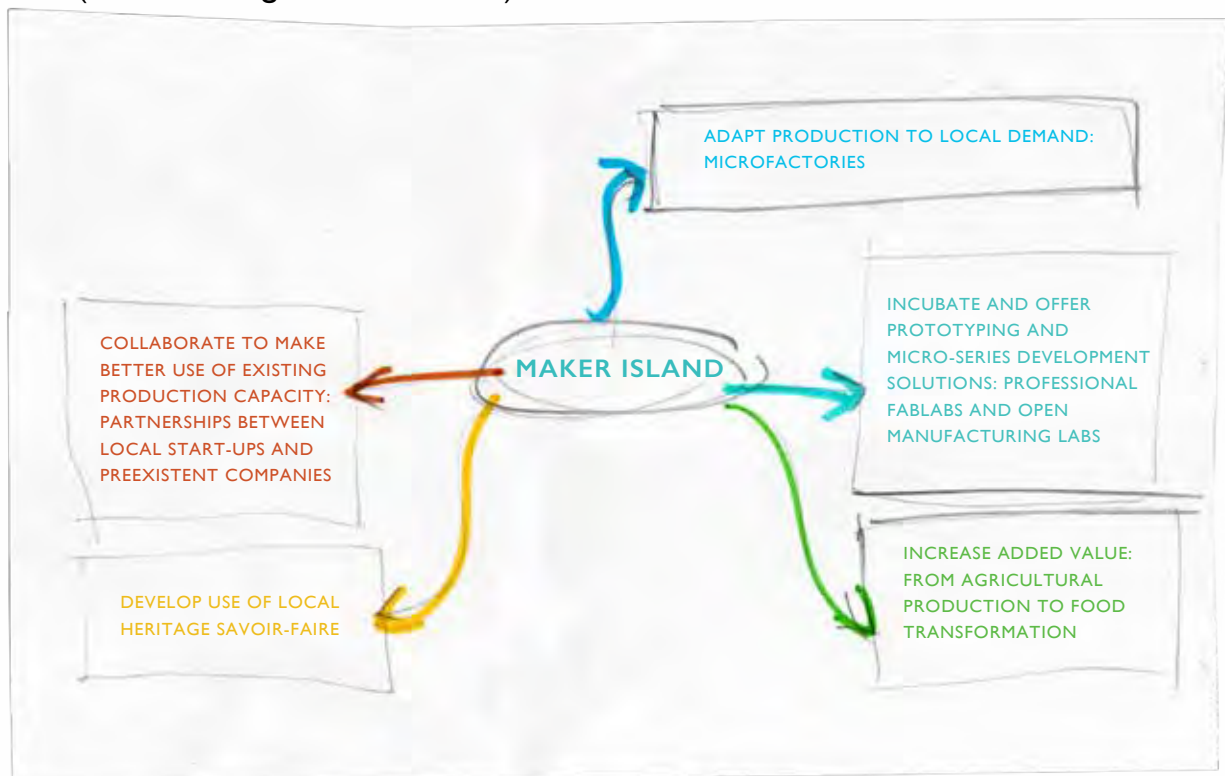
2.1 MAKER ISLAND

Making Mauritius a “maker island ” means increasing its ability to produce what it consumes using local resources (human, material, technical, natural), a move which would require:

- Effectively adapting Mauritius’ manufacturing base to the size of the local market (micro-manufacturing)
- Reclaiming the use of local resources
- Fostering the emergence of a culture of local production

Making Mauritius a “maker island” would have many benefits:

- Increasing the island’s autonomy
- Restoring a trusting social bond between producers and consumers, giving new meaning to employees’ work (I know the people who consume my products and I consume them myself) as well as to the act of consumption (proximity relationships, storytelling about products’ local provenance)
- Tailoring production to the local market’s needs, producing the right quantities within shorter production times
- Reducing environmental impacts connected with the transportation of finished products
- Fostering innovation and continuous improvement of processes and products (« it’s in doing that we learn »)



2.1.1 Adapt production to local demand: microfactories

Local microfactories are closed or shared production units dedicated to producing limited series (a few hundred items) of small or medium-sized goods specifically for the local market: beverages, food, textiles, leatherwork, decorative items, furniture, appliances... These microfactories come in a variety of formats: artisanal microfactories (which make use of traditional manufacturing processes), small-scale production/processing labs (for instance, adjacent to a farm), manufacturing at the point of sale (fabshops) often offering tailor-made goods, assembly microfactories (which assemble finished products from spare parts received from elsewhere), nomadic microfactories, ready-made and modular factory kits (eg. micro-abattoirs), repair or refurbishing workshops (eg. for electronic appliances), micro-production units (eg. micro combined heat and power) or microfactories operating on new digital production models (such as 3D printing, digitizing or collaborative robotics offering a wealth of new possibilities).

Not only are microfactories small in size, they tend to be integrated to more circular and inclusive economic models. To overcome the limits in local resources, microfactories often develop their own recycling (eg. wood, cardboard, ...) and reuse initiatives (eg. making use of unsold food products) or other forms of closed circuit production (eg. making bottles from recycled glass collected from customers).

AUTOMOBILE

3D printing cars in microfactories

Local Motors (LM), is an automaker based in Arizona producing cars with 3D printing technology. The company's business model is built on microfactory manufacturing, open source development and co-creation, a process in which their customers work together with designers, and engineers around the world to accelerate product and technology development. In 2014, LM 3D-printed Strati, an electrical car, in only 44 hours, a printing time which has since been reduced to under 24 hours. In 2016, Local Motors launched Olli, an autonomous electrical bus which allows communication with commuters. LM runs 4 microfactories and has plans for another 100 microfactories worldwide. With the support of significant investors LM could become a new symbol of the digital economy, in which product design relies on input from the community, and production is done locally in microfactories using data communicated via the internet.



CONCRETE

Mobile microfactories to produce cement where it is needed

Roosens is a Belgian concrete producer which developed a mobile and affordable cement microfactory in 2013 which can be placed directly on construction sites. Made from a marine transport container using Stabobloc technology (reducing mortar consumption), this "Quick microfactory" concept allows mobile production of concrete blocks used to build housing, family-type residences (with a production capacity of up to 3 houses/day), as well as of a wide variety of concrete products such as bricks or hollow-core slabs. This microfactory has been successfully rolled out across Africa and South America and also constitutes an effective solution for providing materials to small construction sites in rural areas in France.



FURNITURE

Mauritius imported
67,7M US\$ worth of
furniture in 2017

Manufacturing tailor-made furniture in the city



Unto This Last is essentially a furniture manufacturing workshop located in the heart of London offering tailor-made furniture that can be customized on demand. Located in Shoreditch, Unto This Last features an open workshop at the back of the shop where everyone is welcome to observe the manufacturing process. Olivier Geoffroy came up with this idea as a reaction to the increasing prevalence of outsourced and mass-produced furniture, seeking to offer a new kind of experience to furniture buyers who can witness and take part in the manufacturing of their furniture, as well as perpetuate traditional English know-how.

PLASTIC

Producing plastic parts and products on demand in the heart of the city

Voodoo Manufacturing is one of the biggest 3D printing microfactories in New York City. Equipped with 160 3D printers controlled by a central server, Voodoo Manufacturing specializes in the production of small series of plastic parts, such as material components or promotional items for brands including big players such as Autodesk, Microsoft and Mattel. With a capacity to produce up to 10 000 plastic parts in 24 hours, Voodoo Manufacturing produces all kinds of personalized promotional items for its clients, such as goodies, keyrings, figurines, etc. For instance, in 2015, Voodoo Manufacturing 3D-printed a limited edition of 100 velociraptors for the film premiere of Jurassic World.



FARMING

Fostering the emergence of short circuit farming initiatives with low-cost modular abattoirs

Modulab was created as a service for independent farmers, artisan butchers and other short circuit food businesses that wish to produce quality meat while respecting animal welfare both before and at the moment of slaughter. This equipment seeks to preserve animal wellbeing by guaranteeing optimal hygiene conditions while also limiting water and energy consumption and providing satisfactory economic work conditions. Delivered turnkey 12 months after signing the construction permit, Modulab includes a series of services to effectively manage the facility ("Plan de Maîtrise Sanitaire") including a series of guidelines on how to uphold animal wellbeing (MON) and extensive training for operators at every step of the Modulab production chain. Modulab is available in three versions: mono-species porcine/bovine/ovine (732 m²) and multi-species (1 126 m²).



BEVERAGES

The proportion of alcoholic beverages in household budgets increased from 5,1% to 6,1% between 2012 and 2017, in particular for beer which grew one point (2,1% to 3,1%).

Source: Household Budget Survey, Mauritius stats

Producing beer in microbreweries to promote local culture and products



www.icelandnaturally.com

In the wake of the economic crisis that struck Iceland in 2008, a number of microbreweries sprouted around the country to provide local beer at a cheaper cost than imported ones. In 2012, Icelandic microbrewery **Borg Brugghús**, which brews various beers from local products and matches them with traditional Icelandic meals, won the prestigious prize for "Europe's Best IPA", spurring the creation of other such microbreweries around the island. To date there are 26 microbreweries in Iceland which cover approximately 25% of local demand while also exporting on international markets.

CHEESE

In 2017, dairy product imports in Mauritius reached 100M\$ (of which 732k\$ of re-exports)

Setting up a microfactory to produce cheese as close to the market as possible



French cheese producer **Bel** is setting up microfactories around the world to develop its business in high potential markets without having to build heavy infrastructures. Bel's first cheese microfactory was set up in Côte d'Ivoire in December 2015.

Established in Yopougon, an industrial zone in the city of Abidjan, this microfactory produces "La Vache qui rit" cheese for the Côte d'Ivoire market. With a capacity to meet the country's current demand, this factory constitutes a first step in the brand's development on the Côte d'Ivoire market.

This microfactory is a premiere in the company's development and constitutes a technological prowess, achieving extreme miniaturizing of melted cheese production. This facility was assembled and inaugurated in less than 2 months once the kit was received from the company's R&D center in France in 14 containers.

This facility has a production capacity of 20 million units per year. Due to lack of availability in Côte d'Ivoire, the facility operates with imported milk. Cheese produced on-site is then melted and conditioned into portions by 20 local employees who have received the same training as Bel's employees in France.

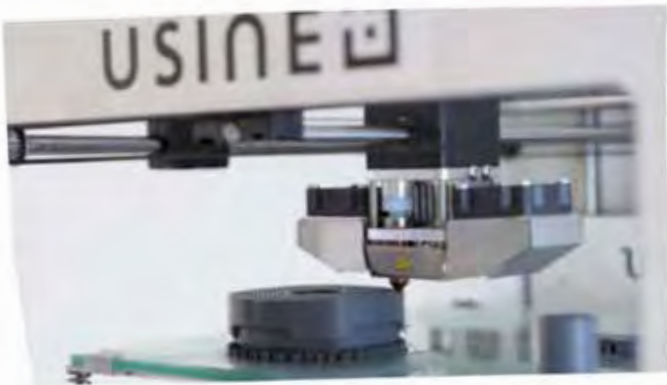


2.1.2 Incubate and offer prototyping and microseries development solutions: professional Fablabs and open manufacturing labs

Professional or corporate Fablabs serve as incubators offering new, swifter solutions for prototyping and the creation of pre- or micro-series, including interesting sectorial initiatives such as “Foodlabs” (food processing workshops which offer a pooling of tools, machines, autoclaves, labeling machines, etc. as well as qualified personnel and certification) or “textile Fablabs” dedicated to design development and the production of limited series of textile products (making professional, specialized machines available alongside textile printers, pooling raw material purchases, upcycling initiatives, sharing experience and know-how...).

R&D

Accelerating product development



Based in Paris, **Usine iO** is a private product development accelerator featuring a hi-tech prototyping workshop dedicated to a product's pre-industrial development phase. Usine iO offers comprehensive expertise and tailored services to assist companies in developing new products step by step, from the initial idea all the way to launching production. Usine iO features over 1,500 m² of workspace, 400 m² of which are dedicated to wood and metalwork, 3D printers and light metal processing machinery, between 200 and 400 m² dedicated to product design, and 500 m² of co-working space which can host up to 60 people. www.usine.io

FOOD

Providing technical support and mentoring for entrepreneurs

Brooklyn Food Works is a 10 000 m² start-up incubator whose goal is to become a “premier platform to prototype, launch, and grow innovative food businesses”. Most notably Brooklyn FoodWorks offers low-cost kitchen space, starting at 300\$/month for unlimited 24/7 access to facilities along with personalized business mentoring. More than 120 entrepreneurs currently benefit from Brooklyn Foodworks services, and over 400 new products have been launched with the support of this platform since its inception, including such products as ZEST Y, POP PASTA or MALAI ICE CREAM.



CONSTRUCTION

Supporting the creation of real estate projects every step of the way



BATI-FABLAB brings together in a single facility all the services needed design and a real estate project, from finding land all the way to building a house, a residential or office building, a shelter, an extension, even furniture.

It is equipped with a pocket factory which automatically produces the parts required for the construction of any project based on its digital BIM model. These components are then assembled on the construction site by artisans affiliated with BATI-FABLAB.

BATI-FABLAB centers bring together the entire real estate ecosystem to serve the local market. It offers real-estate professionals a range of mutualized services in exchange for an annual contribution.

Open manufacturing labs are:

- Places that empower people to design and create objects by offering free access to digital 3D printers with competent personnel to assist in operating them, allowing entrepreneurs, designers, artists, students, hackers or any citizen to easily and swiftly get any idea for an object made into a prototype and if the prototype is conclusive, to move on to the development stage.
- Often set in wider “living-fabs” projects, naturally bringing together a network of manufacturing initiatives, creating innovative ecosystems which are fertile grounds for unique manufacturing experiments (shared, distributed): for instance, Maker Mile (London), Brigades (Riga), Fabrication Athenaeum (Barcelona), which are themselves prototypes for manufacturing ecosystems of the future.
- Open manufacturing platforms inspired by the open-source software movement (such as Opendesk, WikiHouse or OpenStructure) constitute a whole new set of production tools which generate new manufacturing environments with a capacity to meet the demands of an increasingly globalized market while facilitating serial production and economies of scale. This “Design global, manufacture local” model (based on co-creation and open source development) allows designers/engineers to have their designs produced anywhere in the world while also offering an opportunity for micro-production units to broaden their offer and grow their business.

FURNITURE

Sharing open-source models to produce locally

Global players in the furniture industry are keeping a close eye on the development of **OpenDesk**'s trailblazing business model, an open-source furniture platform which manufactures its products in local workshops, a true revolution in the way furniture is designed and produced which eliminates costly and time-consuming shipping, showrooms and storage. Created by international designers, OpenDesk's furniture was specifically designed to be printed with numerical control machines, which means a given item's file can be downloaded and produced locally on demand, anywhere in the world, with the help of OpenDesk's network of manufacturing partners.



DESIGN

Providing the island's community with a multi-purpose fablab



The **NIHERST Fab Lab** (National Institute of Higher Education, Research, Science and Technology) was created by the Fab Foundation in Trinidad and Tobago and is the first initiative of its kind on the island and in the Caribbean. Its goal is to provide the community with affordable access to tools and resources for education, creativity, innovation and professional development. The lab focuses on conception, practical projects, prototyping and robotics. They provide a relaxed atmosphere where locals can share ideas, work on their projects, receive training and participate in workshops or simply tinker.

MACHINES

Offering collaborative manufacturing workshops

The French home improvement and gardening retailer **Leroy Merlin** opened collaborative workshops in Ivry (2000 m²), Lille (2400 m²) and most recently a smaller one in Paris at Station F (650 m²), conceived as a complementary facility to the bigger workshop in nearby Ivry and dedicated specifically to meeting the needs of start-ups hosted within Station F.

Members can access machines and other professional equipment spread over various workshops: wood, metal, textile, electronics, 3D printing... These places offer training to acquire or improve mastery of its equipment, to learn how to use new software or how to make an object from A to Z. Big corporations can hold brainstorming or design thinking sessions as well as three day long prototyping sessions.

The workshops at Ivry and Lille offer:

- Over 2000 m² of workspace
- 10 specialized workshops and 150 machines
- Design spaces with more than 30 computers equipped with professional software
- Collaborative spaces such as co-working spaces, relaxation areas as well as a kitchen
- Teams of experts available to assist members in their projects.



2.1.3 Increase added value: from agricultural production to food transformation

Farmers' capacity to transform all or part of their production, whether on site or via mutualized infrastructures, has become a determining factor in guaranteeing better distribution of value as well as the durability of their operations.

GRAIN

Integrating production and transformation activities



Based in Bragelogne, in the Aube department of Eastern France, the people at the **Ferme des Trois Vallons** farm do everything themselves. They grow grain (their production is in the process of being certified organic) which they grind into flour with a stone mill, a technique which allows to preserve all of the grains' nutritional value. The flour is then transformed into pasta and dried in their farm's workshop. This 100% "Made in Aube" pasta is the result of a 2 year project launched by a couple of grain-producers that wanted to create a finished product out of their grain production. Their manufacturing process is artisanal and slow to guarantee product quality. This pasta is sold mainly in the Aube department (farmers markets, local stores, online...).

CANNED FOOD

Diversifying local production and developing exports

Sarjua is a cannery based in Mauritius and is one of the island's most popular companies. Producing pickles and spices, Sarjua is also a pioneer in cassava and breadfruit flour processing. The company was founded by D. Sarjua, also known as the «Serial Entrepreneur» by the Development Bank of Mauritius. He started his career as a green-grocers and soon became the prime exporter of spices from Mauritius to the French island of La Réunion.

Having since diversified production to include pickles, jelly, spices and tea leaves among other food items, Sarjua makes a point of using only local fruits and vegetables. Sarjua's products are additive-free and have swiftly conquered the markets of Mauritius and Europe. Since a few years, D. Sarjua is seeking to develop gluten-free flour production made from cassava and breadfruit. Today Sarjua employs over 80 people.



Processed food and beverage imports have increased from 322M\$ (of which 29,6M\$ of re-exports) in 2007 to 669M\$ (of which 69,8M\$ of re-exports) in 2017.

MEALS

Offering locally-produced ready-to-cook produce and meals as an alternative to imported processed foods



Kit Pou Kwi



Based in Thailand, **Kit Pou Kwi** (KPK) delivers fresh ready-to-cook produce and meals to its customers door. Offering 25 recipes each week in the form of pre-peeled, clean and cut ingredients delivered with preparation instructions, KPK's goal was to offer local consumers healthy food options without the hassle of wasting time at the grocery store.

KPK also aims to prevent waste by offering its customers single portions. Fruits and vegetables are selected « at local farmers concerned with sustainable agriculture ». Fruit and vegetable peels are used to make compost which is then used by local partner farms. KPK's meal boxes are made from 100% recyclable materials.

The proportion of household consumption dedicated to restaurants, cafés etc. increased from 4.3% to 5.1% between 2012 and 2017, spurred by the increase in consumption of ready meals (2.4% to 2.8%) as well as cakes and snacks (0.4% to 0.9%).

2.1.4 Making use of local heritage

Unique local resources and savoir-faire are opportunities to create one-of-a-kind products that stand out for their high quality and authenticity.

BEVERAGE

Developing new industries from local plants



V Kanhye Health Foods Co. Ltd was founded by young Mauritian entrepreneur Vinay Kanhye when he set out to create a brand of herbal teas made with Mauritius' very own *Moringa Oleifera*, a local plant most commonly referred to as "Brede mouroum". Known for its many health benefits, *Moringa* grows in abundance on the island though its potential was largely ignored until Vinay Kanhye realized what an incredible resource it could be. He launched large scale 100% organic *Moringa* production at Grand Aube and set up a factory on the second floor of his house to process harvested moringa leaves into tea bags.

4 years later Vinay Kanhye's farm displays over 3000 shrubs over more than 6 acres of land. His brand is certified ECOCERT by both Mauritian and French standards. In 2017, he won the SME Innovation Award for the most innovative small/medium sized company, awarded both for the quality of his brand's product and of his production process.

BEVERAGE

Exporting bottled coconut water



Coco Up sells bottled fresh coconut water from Mauritius. Arnaud Dalais launched Coco Up in 2009, bottling the first 16 liters of coconut water himself in his own garage with the help of a friend, and selling them in a little store at Roches Noires, a village on the North East coast of the island. Since then the company has grown considerably, Coco Up can be found on Emirates Airlines, at Colette concept store in Paris and in practically every store on the island of Mauritius.

Today Arnaud Dalais employs over 15 Mauritians and works with a number of coconut retailers on the island to produce the brand's 100% natural bottled coconut water as well as new coconut-based food products such as coconut sorbet, coconut creme, coconut milk and coconut chutney, among other products. 70% of waste produced is also reused: coconut shells are used on farms, while coconut straw is used by local hotels as fuel for their wood-fired ovens. Arnaud Dalais is also considering producing coconut straw compost to use as fuel to produce his own electricity

BISCUITS

Producing world famous biscuits made from a local root

BISCUITERIE H. RAULT has been world-renowned for its cassava biscuits for over 140 years.

In 1868, Hilarion Rault created a recipe for biscuits made from cassava that was inspired by traditional biscuits from the Bretagne region of France. Encouraged by his friends and family he created a business and started selling his "Biscuits Manioc" on the local market in 1870, a biscuit which is still produced by the family business in an artisanal fashion to this day. These biscuits, made without milk nor egg, received the silver medal at the « London Exhibition » in 1908.

Used to import cassava from Madagascar for its production for many years the Biscuiterie has turned to local cassava suppliers.

Biscuiterie Rault's has a maximum production capacity of up to 1000 boxes per day and produces at the very least 300 boxes per day, i.e. 12 000 biscuits per day.



2.1.5 Collaborate to make better use of existing production capacity: partnerships between local start-ups and preexistent companies

Collaboration can be a determining factor in the success of an entrepreneurial project, by facilitating the critical stages of prototyping and production launch.

READY MEALS

Making use of local SMEs existing productive equipment to develop innovative products



Manufacturing SMEs and medium-sized companies (such as prototype development companies and subcontractors). Though they hold great potential for creating new locally-anchored economic dynamics (« produce local/consume local »), in particular due to their greater agility in adjusting their production to meet specific consumer needs, these players are often missing from “innovative” production ecosystems and communication channels. For such SMEs and mid-sized companies, engaging with local markets can be an opportunity to diversify their production and find alternatives to working as subcontractors (and therefore limit their dependency on one or more big accounts) as well as create partnerships with local start-ups, in particular by making under-used production facilities available to them.

Lyon-based food start-up **Ici&Là** has set out to offer innovative and tasty alternatives to meat made from French-grown organic legumes.

In 2016, Ici&Là launched a line of products designed for the mainstream under the brand “Le Boucher Vert”, which included vegetarian meatballs, steaks and nuggets made from lentils, chickpeas or flageolet beans.

Having tested the market, Ici&Là invested in machines which were set up in the facilities of an industrial partner specializing in the production of frozen fruit and vegetables in the nearby Drôme region. This smart partnership allowed Ici&Là to launch an industrial production line without having to set up its own factory, simply by making use of unused workspace in its partner’s facilities and providing its knowhow and adequate training to the facilities’ operators.

FRESH FRUIT AND PRODUCE

Create partnerships with supermarket chains to distribute products grown, prepared and conditioned in the vicinity of a supermarket

Hydroponics is a subset of hydroculture whereby plants are grown without soil in a nutrient-rich water solution. Recent technological progress in this field has spurred widespread use of this kind of agriculture. Hydroponic farms are ideal for rooftop agriculture in particular as they offer high return while being cheaper to run than ground operations. Hydroponics consume less water by making use of rainwater. In the USA **Brightfarms** has set out to create and run hydroponic urban greenhouses on the rooftops of supermarkets or in their vicinity, offering these supermarkets the possibility to distribute their own agricultural production and operate in shorter circuits with higher quality control. The costs for setting up and running these facilities is not covered by these supermarkets, however they must commit to buying the entire production of these hydroponic farms for the first 10 years of their operations.





HOW ICELAND BOUNCED BACK FROM THE 2008 FINANCIAL CRISIS BY PROMOTING INNOVATIVE “MADE IN ICELAND” INITIATIVES

Due to the Icelandic economy's historical reliance on international financial markets, the island was hit hard by the financial crisis of 2008. However, the country has bounced back and Iceland's economy is on track again. National revenues per inhabitant, which had dropped sharply following the crisis from 61,9k\$ per inhabitant in 2007 to 36,5k\$ in 2010, has gradually returned to pre-crisis levels. Iceland was able to recover from the crisis by diversifying its economy with a new focus on entrepreneurship, a transition made possible by a variety of stakeholders:

- The Icelandic state loosened its corporate legislation to enable easier business creation, creating new tax incentives and increasing research and development funding;
- Universities focused on innovation and entrepreneurship, providing training on how to start a business and systematically requiring that academic knowledge be applied to industry;
- **Private companies and banks contributed to this entrepreneurial dynamic by funding startup accelerator programs such as Klak (now called Icelandic Startups) which was founded in 1999 by Nýherji, one of the biggest IT companies in the country, while Arion Bank, one of the island's main banks, launched a partnership with Icelandic Startups to create the startup accelerator program Startup Reykjavik.**

Startups are flourishing in particular in the tech, internet and telecommunications industries, as well as in the renewable energy sector, the fishing industry and more recently online gaming, augmented reality, health and biotechnologies.



ICELAND OCEAN CLUSTER

Iceland Ocean Cluster's mission is to support Icelandic entrepreneurs and businesses dedicated to using fish as a resource for non-food related industries, investing its resources in new marine spin-offs and projects that manufacture health and beauty products, medical products, leather, etc.



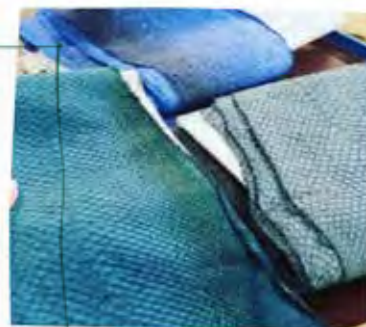
CODLAND

was founded by the Iceland Ocean Cluster in 2012. This start-up is on a mission to create value from unused parts of fish by manufacturing products such as dietary supplements rich in calcium and minerals, omega-3 rich fish oil, fish-based animal foods, marine collagen for the cosmetics industry... Hence this start-up transforms a low-complexity, partly underexploited (unused waste) product that is mainly destined to be exported into a complex fully-exploited product with a variety of uses.



ATLANTIC LEATHER

Leather is another inspiring example. This Icelandic tannery manufactures leather from fishskin in an environmentally friendly way, sourcing fishskin from the fishing industry which would otherwise constitute waste. Similarly Atlantic Leather manufactures leathers from other animals (horse, sheep, etc.) using skins sourced from the local farming industry.



www.atlanticleather.is

Finally, MARINOX

is a startup specializing in the extraction of bioactives from marine algae found on the Icelandic coast. The company's extracts are used in health, nutrition and personal care products.



www.marinox.is



“Looping the loop” of local economic and material circuits to make Mauritius a “circular island” can be a powerful generator of wealth and innovation.

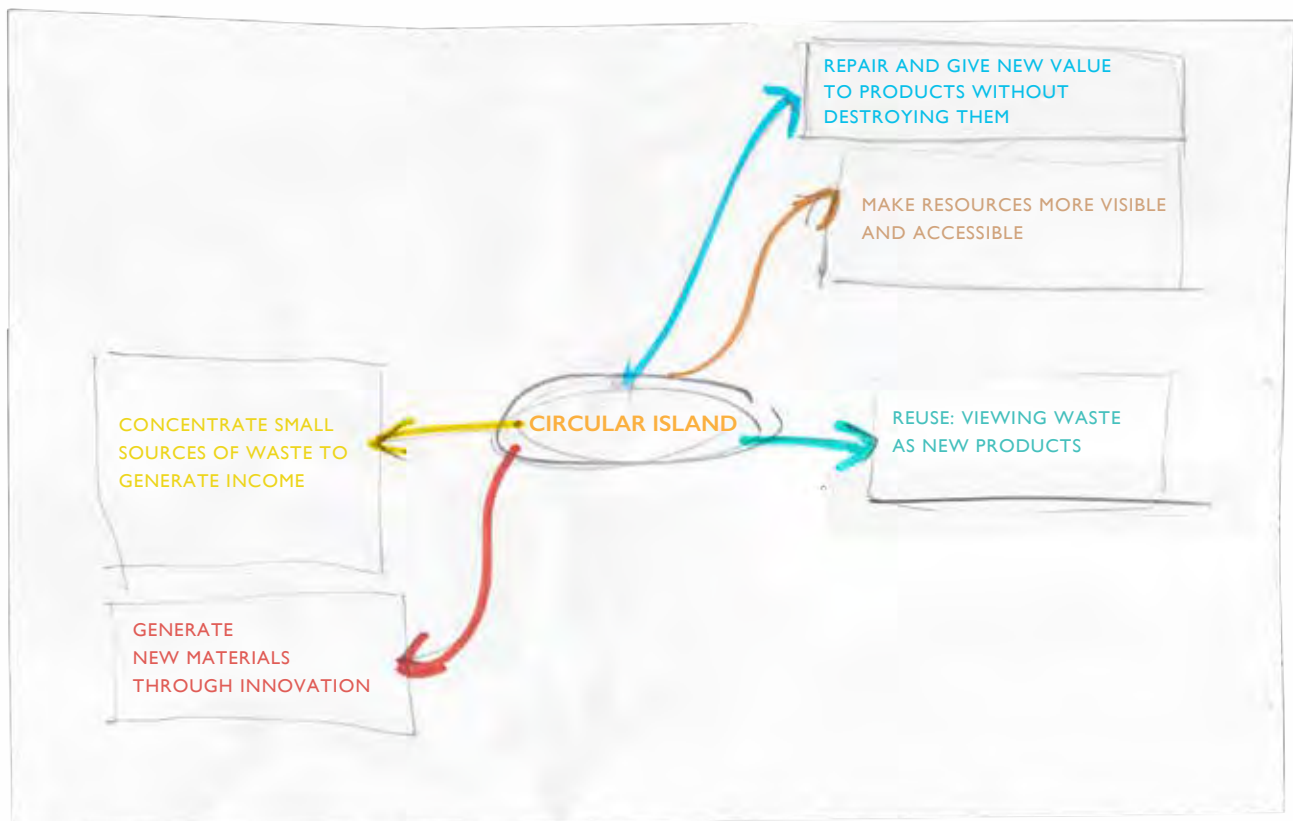
2.2 CIRCULAR ISLAND

Looping economic and material flows to make Mauritius a circular island is a sure way to foster innovation and creation of wealth. Instead of working with imported raw materials, the island could take advantage of existing material resources, both primary or secondary, in particular by using local inputs extracted from recycling, repair or reuse. Such a strategy would require:

- Shifting the island's perspective on its own material resources to identify and foster the emergence of new ones
- Establish specific productive know-how every step of the production chain, from raw materials to end-product
- Develop innovative savoir-faire to make use of existing waste (agricultural, industrial, household) or surpluses as inputs

Replacing PITO (Product In - Trash Out) approaches with local loops would allow the island to:

- Reduce imports of raw materials
- Limit extraction of natural resources
- Reduce waste
- Maximize value from local materials and products



2.2.1 Repair and give new value to products without destroying them: from product to product

Repairing existing products is the first step to reducing the island's dependence on imported materials and products.

EQUIPMENT

Generating local jobs by reducing waste and giving new life to used electrical and electronic equipment



Created in France in 1984, **Envie** is a nationwide network of companies employing long-term unemployed workers to repair household electrical appliances and sell them at a low price. Operating within the principles of both the social and solidarity economy and the circular economy, Envie has expanded its activities to include recycling of WEEE (Waste Electrical and Electronic Equipment) since 2006, when France's law instituting Extended Producer Responsibility (EPR) for WEEE came into effect. Today the network processes one third of France's end-of-life electrical and electronic products. Thanks to partnerships with eco-organizations such as Éco-systèmes, Recylum and Ecologie, as well as with distributors such as Darty and manufacturers such as Philips, Envie repairs or recycles 100 000 tons of WEEE per year. Operating a number of treatment sites, recycling facilities, logistics operations, repair workshops and retail stores across the country, Envie's network includes over 50 companies across France, employing 2 500 workers, of which 2000 are being reintegrated into the job market, and collecting 1/3 of all French electrical and electronic waste.

BOTTLES

Creating local industry dedicated to reusing glass bottles

Recycling is good. However, breaking single-use glass and melting it at a temperature of 1500°C requires a significant expenditure of energy. Reusing is better! Glass is an unalterable material which can be used over and over again. Industrial washing processes and high quality standards guarantee that reused bottles are as good as new. Launched by Cluster'Jura and Juratri in the Jura region of Eastern France, the “**J'aime mes bouteilles**” initiative collects wine bottles in 20 locations in and around Lons-le-Saunier (hypermarkets, grocery stores, Biocoop stores, a semi-large collection point for wine producers) to resell them to local wine producers. This local circuit is particularly beneficial to small wine producers for who bottles are a big investment.



GLASSWARE

Creating glassware design objects made from recycled bottles



MGG
MAURITIUS GLASS GALLERY
hand made art



The **Mauritius Glass Gallery** is a glass foundry created in 1991 by Phoenix Bev to recycle glass waste produced by its industrial activities. The company's original glassware design items are hand-made locally by a team of glass blowers, constantly striving to improve the design and technique of these recycled glass objects.

MGG's glass objects have since earned their place on the contemporary glassware scene and gotten the attention of local interior designers. They supply top hotels with glass and tableware, companies with corporate gifts and employee awards, and the local Mauritian market with interior design objects, gifts and souvenirs.

These last years MGG has been striving to improve its environmental performance by using recycled plant oils as fuel for its furnaces, rainwater for glass polishing and used newspapers to protect glassblowers hands on site.

2.2.2 Reuse: viewing waste as new products

Current technology allows to reuse most materials that make up household and corporate consumer goods, limiting environmental impacts associated with raw material extraction and imports.

GLASS

Transforming glass into an innovative product



Recy'Verre is a Caledonian domestic glass recycling company located in Numbo, on the peninsula of Ducos. Recy'Verre aims to reduce environmental and economic impacts associated with glass end-of-life while generating local jobs for previously unemployed workers. Rather than burying it or sending it to France, Recy'Verre collects glass waste (pots, jars, mirrors and windows, etc.) and gives it a new life in the form of crushed glass aggregates which can substitute mostly imported calibrated sands and gravels used in the construction industry, as well as water filtration, decoration, landscaping activities etc. This product reduces the island's ecological footprint by offering a readily available and reusable mineral material alternative to imported mineral aggregates. Over 680 tons of glass are treated every year.

WOOD AND FURNITURE

Reusing wooden pallets

Founded in 2015 on the French island of La Réunion, **EcoPAL**'s goal is to recycle unused wooden pallets and transform them into new products. EcoPAL brings together both private sector companies and non-governmental organizations associated with La Réunion's wooden pallet industry, constituting the island's very first "Pôle Territorial de Coopération Economique" (PTCE), or Territorial Economic Cooperation Hub. At the top of the production chain, recycling company AC2V collects, sorts and repairs used pallets. Waste from that process is reconditioned into raw wooden boards by prisoners employed in a workshop operated within the Port's penitentiary. These boards are then sold to private customers and local artisans. Furthermore, local NGO "Les Palettes de Marguerite" uses pallet wood as raw material to manufacture tailor-made furniture, employing workers who have been reintegrated to the job market. Woodwork projects born from EcoPAL are showcased on the initiative's website to inspire customers and workers alike.

Thanks to EcoPAL, 10 to 15 tons of wooden pallets are treated every month, and a dozen jobs have been created on the island in 2017: 5 at "Les Palettes de Marguerite", 6 at the Port detention center and 1 at AC2V.



Making furniture from all kinds of waste materials



Extramuros is one of the pioneering companies in France when it comes to upcycling. Founded in the Paris suburb of Gennevilliers in 2007, Extramuros manufactures objects from all kinds of used materials. Woodwork is the company's main area of expertise, designing and manufacturing items such as conference tables, desks, reception desks or ecofriendly trophies made from different kinds of used wood (old furniture, flooring, construction site waste, beams, pallets, etc.). Furthermore, Extramuros is committed to offering employment to workers who have been out of the job market for a time and providing them with training and supervision from experienced professionals.

CONSTRUCTION

In 2017, Mauritius imported 934k\$ worth of glass wool (and other glass fiber products) of which 179k\$ were re-exports.

Manufacturing insulation from recycled local cardboard

Novidem, is the first insulator manufactured from local recycled cardboard. Cardboard is an economical and effective source of insulation. French company IDEM (Innovation Développement Eco-Matériaux) created Novidem, a cellulose wadding made from recycled cardboard fiber (made from 85% of recycled raw materials) which performs well technically, environmentally, as well as in terms of health impacts. Recycled cardboard used in this process is mostly sourced from the local cardboard industry, using cardboard scraps and trimmings as well as defective cardboard sheets. Furthermore, IDEM has a partnership with the French city of Chalon-sur-Saône to collect and reuse cardboard from the city center's shops and businesses.



TEXTILE

Recycling outdoor textile products in a creative way



OWL - Outdoor Waste Lab is a creative laboratory which collects and recycles textile waste from the outdoors textile industry to manufacture small-sized upcycled luggage accessories. Upcycling is the process by which waste is made into something new, beautiful and useful. OWL collects used garments from partner brands, cuts, reassembles and sews them to create made-in-France upcycled luggage accessories produced in the heart of the Mont-Blanc Valley, in the French Alps. Each OWL product is unique, often displaying wear from its materials' previous life.

Making sustainable bio-textiles by using left-overs from food crop harvests.

Crop-A-Porter is a start-up that takes the harvest remains of crops such as oil-seed flax, hemp, sugarcane, bananas and pineapples and turns it into useful bio-fiber through a low-cost, closed loop technology. This bio-fiber can then be turned into textile fabric. In 2018, Crop-A-Porter won the Global Change Award sponsored by H&M.

Crop-A-Porter is the brainchild of American entrepreneurs Yitzac Goldstein, Geof Kime and Isaac Nicholson who together set out to find solutions to wean the garment industry from its dependency on cotton, the world's most widely used natural fiber. They created a system called Agraloop™.

Agraloop™ Bio-Refinery transforms food-crop waste into valuable natural fiber products in a cost competitive and scalable way, providing sustainable and regenerative benefits. Agraloop™ can use a range of feed stocks including oilseed hemp and oilseed flax straw as well as pineapple leaves, banana trunks and sugar cane bark. These 5 crops alone produce 250 million tons of fiber a year, equivalent to over twice the world's current fiber demand.

Crop-A-Porter



COSMETICS

Growth of perfumes
and cosmetics imports:
From 31M\$ in 2007
to 76M\$ in 2017

Extracting cosmetic active ingredients from banana waste

Based on the French island of La Martinique, **Kadalys** is the first cosmetic brand to use banana extracts. Banana is the Caribbean's most exported fruit and is produced massively in the region: 300 000 tons are produced every year, alongside 40 000 tons of banana waste. This unused waste is Kadalys' resource to create Made in Martinique skincare products, a business model especially well adapted to tropical insular economies. Kadalys activities eliminate losses for the banana industry hence maximizing the economic benefits of banana production.

According to Kadalys' founder Shirley Billot, the key success factor in this kind of initiative is to work with an established and well structured agricultural industry to guarantee secure and lasting operations. Kadalys works with local banana producers both in Martinique and Guadeloupe. Furthermore, she recommends expanding business beyond local markets, to generate greater revenues as well as strengthen the island's influence and reputation on an international scale. Created in 2012, Kadalys displayed a turnover of 700 000€ in 2016, half of which was generated from export.



ENERGY

Using waste as fuel for vehicles



KARRGREEN is a gas station distributing bio-NGV produced from methanization. Based in the city of Locminé in the French region of Bretagne, this gas station is the fruit of the city's commitment to effecting the area's ecological transition by means of LIGER, a Mixed Economy company dedicated to investments in digital and green technologies.

Bio-NGV, or biogas, is a renewable energy produced during the anaerobic digestion of biomass: sludge from water treatment facilities, agricultural waste as well as effluents from a dozen farms. Annual production represents approximately 550 000 liters of gasoline, generating savings of over 2 million euros that would otherwise be spent on oil procurement.

Growth of fuel imports
from 647M\$ in 2007
to 836M\$ in 2017

ENERGY

Collecting local plant oils to produce electricity

Assiette verte and **Alizés Energie** have formed a winning partnership for the French island of New Caledonia. Assiette verte is dedicated to collecting used plant oils from over 300 suppliers on the island (restaurants, school canteens and food industries) to produce biofuels by distillation, filtering and processing with centrifuges.

Alizés Energie is a local company of the ENGIE group that collects plant oils via its network of recovery containers across the island as well as its plant oil recovery tanks installed in waste treatment facilities. These oils are used as fuels for the electric plant at Lifou as well as the two hybrid electrical plants on the island of Ouen which produce 100% renewable energy. 120 000 liters of used plant oil are processed this way every year.



**ALIZES
ENERGIE**
engie

TIRES

Giving new life to used tires



The “Association pour la Valorisation des Pneumatiques Usagés de la Réunion” (**AVPUR**) – Association for the Reuse of Used Tires of the island of La Réunion – is a federation bringing together the island’s tire importers to collect and reuse tire waste. Used tires are collected and stored by Solyval. Collected tires are then ground into chips and aggregates which are processed to be used as impact-absorbing ground-cover, asphalt coating, draining surfaces and underlays, road pavement. Created in 2003, this industry association included 46 importers from the automobile, construction and agricultural industries in 2013. Since its inception, it has reused 4 million used tires, amounting to over 2000 tires collected per day in over 300 collection sites across the island.

URBAN DEVELOPMENT

Renovating an avenue with concrete made from shells

A team of engineers from the **Ecole Supérieure d'Ingénieurs des Travaux de la Construction de Caen** in France launched an initiative in 2011 to develop pervious concrete made from crushed scallop shells sourced from the local food industry. Their unique formula was patented after three years of research and got the attention of the city of Wimereux, which recently renovated its avenue Foch and surrounding parking lots using this innovative technology.

Not only does this shell-based pavement solution create value from local waste and avoid environmental impacts associated with making traditional concrete from mineral aggregates extracted from the mining industry, it also prevents rainwater runoff and flooding as crushed shell aggregates are pervious to water, allowing rainwater to infiltrate local soils.



ZERO WASTE

Producing and selling local compost



OZD was established in 2014 with the goal of achieving Zero Waste and 100% recycling on the French island of New Caledonia. This small company specializes in collecting, processing and reusing different kinds of packaging waste, from paper and cardboard to industrial glass, as well as plastics, woods, green waste, meat waste and food waste from the island's restaurants and canteens, as well as inert waste.



OZD has also launched production and commercialization of 100% local compost made from topsoil, crushed glass, cullet gravel and organic fertilizer. Organic fertilizers are natural, which means they are made from raw materials sourced from living beings, whether animals or plants. They release nitrogen, phosphorus and potash into the soil in varying quantities, which are gauged to guarantee plants don't receive too many nutrients too soon and ensure they grow at a normal pace.

SPORT

Collecting and recycling surfboards on location

The **Resurf Project** was created to give new life to used surfboards, considering that approximately 100 000 surfboards end up in landfills every year... Surfboards made from polyurethane are not recyclable, polystyrene boards are. These are the kind of boards used in surf schools, in a number of other water sports as well as by lifeguards. The Resurf Project is a four step initiative: collection, delamination, polystyrene crushing and compacting to reduce transportation and recycling costs, transformation of polystyrene blocks into boardstock foam by a polystyrene recycler to be used as raw material for the manufacturing of new surfboards by a company called Hoff. 1 000 used boards can yield 420 new surfboards with this recycling process.



TEXTILE

A world leader in carpet manufacturing recycles fishing nets to support local communities

Interface



Launched in the 70s, the American carpet manufacturer **Interface** realized in 1994 that it needed to move from a linear to a circular production model. A major fuel consumer, the company is a pioneer of sustainability with the goal to eliminate all of its operations negative impacts on the environment by 2020. The company has consequently radically rethought all of its operations, products and business practices.

In particular, the company has launched Net-Works®, a series of projects for purchasing used nylon fishing nets from fishing communities in developing countries. The company then recycles these nets, which otherwise often end up dumped on beaches or in the sea. The damage from such practices to the Danajon barrier reef in the Philippines, for example, is immense.

Interface works with local partners, particularly NGOs, to organize the collection of nets from villages. In this way, as well as reducing its environmental impact, Interface also supports local communities by funding local NGOs.

Making clothes from recycled plastic recovered at sea

Launched in 2009, **ECOALF** is a Spanish clothing label whose products are made from 100% recycled and recyclable materials.

The company uses plastic waste recovered from the Mediterranean sea by 200 fishing boats from Valencia, which systematically collect saturated polyester (PET) waste objects during offshore trips.

In a two month-period, for example, it is possible to retrieve 4 tons of waste from the sea, including two tons of plastic which can be 'upcycled'. This plastic waste is then transformed into flakes in a factory in Chiva, near Valencia, before the flakes are made into thread by the Spanish company Antex, in Girona (Catalonia). Ecoalf makes coats, swimwear and bags from this thread.

On average, the company uses 35% plastic waste from the sea, and 65% from land sources. However, its long-term goal is to use recycled thread made 100% from waste collected at sea, in order to "make people aware of what is happening under the surface of the Mediterranean".

ECOALF



2.2.3 Make resources more visible and accessible

Beyond technical and economic solutions, the development of industries that give new life to waste requires a significant cultural change in our relationship to waste. To effect this paradigm shift, the potential of waste as new resources must be made visible to companies and households.

MATERIALS

Creating an outlet to replace mining activities with eco-dumps



The company **Yprema**, an independent French SME, is engaged in the processing of demolition materials, waste ashes and inert clay. It selects, values and recycles these materials, before delivering a finished product to civil engineering firms. Since 2012, Yprema has provided a workshop called “l’espace artisan” in Seine-et-Marne, which companies can have access to through a paid membership scheme. In order to reduce the burden on public waste disposal, and offer workers a real alternative to traditional waste disposal, this site allows for all types of waste to be unloaded and exchanged for quality natural and recycled materials, either in bulk or in big bags. At the site, electric and electronic waste, construction waste, wood, glass, metals and certain dangerous waste materials can be exchanged for recycled materials (eg. concrete gravel) and natural materials (eg. sand).

EXCHANGE

Creating a new kind of supermarket where consumers can trade and recycle waste

Smicval Market is an innovative waste disposal site where consumers can recycle, donate and recuperate waste objects to give them a second life. Opened in Vayres, near Libourne (France) on April 10th, Smicval is a type of supermarket where residents can dispose not only of waste objects, but also of old items they no longer use, exchanging them for objects left by other residents. What cannot be reused can be recycled, and all for free.



EXCHANGE

Helping Mauritians to sell, buy, exchange and swap their goods and services



Weshare.mu is an online platform on which Mauritians can sell, buy exchange and swap their goods and services. It was created to give a second life to objects that hang around unused in people's homes.

In 2016, the weshare.mu team took on the mission of connecting Mauritians through a "sharing economy", in order to facilitate the exchange of used goods and of services, both to preserve the planet and increase islanders' purchasing power.

There are 12 categories of products on the site, including: multimedia, vehicles and equipment, real estate, home, children, fashion & well-being, hobbies and entertainment, local life and events, animals, services, professional equipment and more. In 2018, the platform listed more than 13 000 adverts.

2.2.4 Generate new materials through innovation

Innovation in the fields of material chemistry and green chemistry have allowed for the exploration of new means of recycling: more efficient processes, new deposits of matter, and additional functionality... There are many opportunities developing across all sectors.

PAPER

Un-printing paper



The company Epson has developed **PaperLab**, an "un-printer" which gives a second life to paper within companies and for printing professionals. This machine is capable of recycling 14 sheets of A4 per minute. Inside the machine, a three-step process takes place: paper is reduced to fibers, ink is removed, and finally, chemicals are used to recompose fibers, re-binding them in order to turn them into new sheets of paper.

The traditional recycling circuit for paper is long. Used paper has to be transported from offices to a recycling factory before it can be re-introduced into the commercial paper chain. PaperLab is Epson's initiative to shorten this process, and re-locate the recycling process within the workplace. This invention will also create new opportunities with printers for local paper recycling companies.

SPINNING

An inventive way of making thread from old socks

Since 2008, French NGO “**Chaussettes Orphelines**” has been collecting, recycling and transforming old socks that would otherwise have been thrown away. It has developed a type of thread made from recycled socks, which can be used to make clothes (eg. socks, sweaters, and dresses), and is also used in special collections created by the association’s founder-creator, Marcia de Carvalho.

The clothes are designed in solidary workshops, which train disadvantaged persons from the Goutte d’Or neighbourhood in Paris. The association also works with partners to accompany the apprentices when they return to work.

Environmental concerns are also at the heart of the association’s work. “Chaussettes Orphelines” organises year-round collections of socks, providing it with a supply of raw materials while also raising public awareness of the need to reduce textile waste.

The association is funded by the sale of its clothes, which also contributes to the revival of the spinning and knitting industries in France, and to social inclusion. In France, 900 000 tonnes of waste from clothes and shoes are produced each year, but only 150 000 tons are collected.



TEXTILE

In 2017, 432M\$ worth of textiles were imported to Mauritius (including 38M\$ of re-exports) for an export market of 819M\$

Giving new life to textile fibers



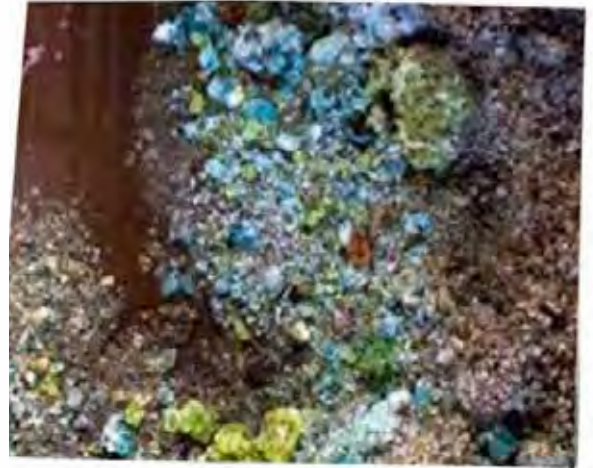
The recycling of fabrics is a delicate process, in particular when it comes to very popular mixed fabrics such as polyester and cotton. **Regenerator**, one of the winners of the 2018 Global Change Award, has invented a circular technology which uses an environmentally-friendly chemical to separate and regenerate these cotton polyester mixes into a new, completely usable textile fiber. The process breaks down the polyester, while leaving the cotton intact.

The team is now targeting industrial fashion networks outside its own geographical region. Under a program to accelerate innovation, Regenerator wants to strengthen confidence, and help others understand the importance of their research. Subsidies from the Global Change Award will improve, optimize and extend the Regenerator process.

RARE EARTH METALS

Recycling highly precious rare metals

Hydrométal is a recycling company based in Engis (Belgium) which handles a wide range of raw materials, by-products and complex industrial waste containing non-ferrous metals. The hydrometallurgical treatments carried out by Hydrometal are an invaluable alternative to the landfill method of waste disposal, and also contribute significantly to the development of sustainable solutions for reducing consumption of natural resources. In particular, Hydrometal has developed a method of producing salts and oxides/carbonates from rare earth metals, which are indispensable for use in wind turbines, optical fibers, electric cars and energy-saving light bulbs. China supplies 95% of global demand for rare earth metals.



CEMENT

Using recycled plaster vs. imported gypsum in cement production

Since 2012, **STS** has been recycling wood, concrete, tiles, and other construction site materials on the French island of La Réunion, but until recently it was not able to recycle plaster panels from demolition and construction activities. These were either buried in special pits, or exported. Meanwhile, a few kilometers away, the Bourbon Cement Company was importing gypsum from Asia for its activities, which could have been sourced from these local untreated plaster panels.



Hence the company invested in the creation of a local plaster waste recycling chain and established a technique for sorting, grinding and sifting plaster waste to produce a powder to be used as a substitute for gypsum in cement manufacturing.

STS has received support from the French governmental Agency for the Environment and Energy Management (ADEME) and the French national construction association as well as the local development agency to cover new equipment expenses. STS also operates in partnership with neighboring local authorities, major contractors, local industrial players and GREEN (Regional Group of Environmentally Engaged Enterprises).

In spite of governance problems in 2018, the technical solution provided by STS has been a success and is likely to be pursued.

2.2.5 Concentrate small sources of waste to generate income

One of the challenges for small territories is achieving a critical mass of waste collected, in order to implement recycling and upgrading activities. To this end, certain companies have turned their logistical and awareness-raising expertise into a business activity.

METALS

Exploiting 'urban mines'



Menut Recyclage is a key player on the recycling market in the Centre region of France. This company specializes in the collection of scrap metal and non-ferrous metals (such as copper, aluminum, brass, zinc, stainless steel, and lead) from individuals, garages, artisans, industrialists, farmers and local communities. Metals are collected by truck, before being sorted (manually or mechanically), processed (by shearing or crushing), and upgraded – with the recycled metals being sold to the steel industry (steelworks and smelters) as secondary raw materials.

FOOD

Providing B2B expertise on recycling of unsold food



Phénix Phénix is a French social enterprise which assists its professional clients (major distributors, industrialists, the events sector) in resolving problems of waste reduction and recycling. Phoenix organizes the collection of unsold articles for associations (recuperating part of the tax exemption on gifts received by the distributor) and is also developing recycling channels for animal feed, and for the processing of fruit and vegetables into jams, confectionery, soups, alcohol (beer, wine), and paint, and supplying restaurants which operate anti-waste policies. Phénix is developing its activities across all French regions (it has 15 branches), in order to find solutions for waste reduction that are as close as possible to the source of the surplus.

PAPER

Providing a full recycling service for office waste

Founded in 1997, the **ELISE** group sprung from the idea that collecting and recycling office paper could provide stable employment for people in precarious situations. By sorting waste on-site, and using short recycling circuits in nearby locations, ELISE guarantees maximum levels of recycling for these sources of waste, in adherence with national recycling regulations for certain types of waste which are treated by specific governmental eco-organizations. ELISE also offers associated services (unpacking, destruction of confidential documents, cleaning) and recycles 10 types of office waste (including paper, cardboard, plastics, batteries, ink cartridges, lamps). The company has branched out across France, signing franchise contracts with local structures, companies dedicated to reintegrating unemployed workers to the workforce, and sheltered workshops.



PLASTICS

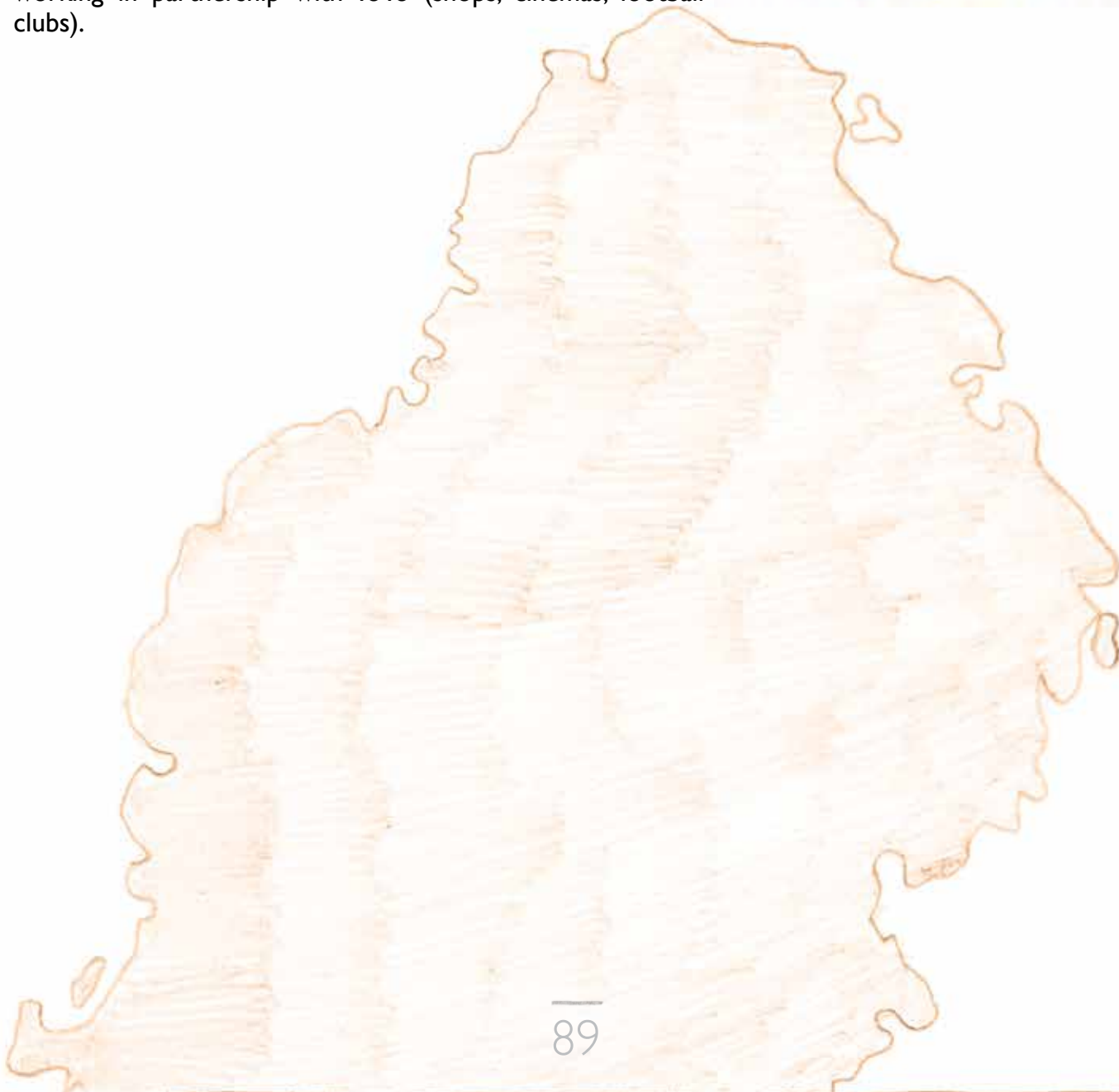
Using innovative programs to collect non-recyclable plastic products and re-insert them into a new production



TerraCycle eliminates the idea of waste by 'recycling the un-recyclable.' TerraCycle collects and recycles all types of waste, including food packaging, flasks for stewed fruit, cosmetic packaging, coffee capsules, used pens from schools, and plastic gloves used in factories. The company works with individual collectors (who are paid using a system of points that can be cashed in as gifts), large companies, SMEs, local businesses and cities in over 21 countries, diverting billions of waste items from burial and incineration. Once collected, these items are cleaned and melted down into hard plastic, which is then remodelled into new, recycled products.

Coaching residents to increase local recycling rates

Yo-Yo is a start-up which has created a system of collecting household plastic waste door-to-door in order to recycle it. Participants are invited to sort their plastic waste at home, and once bags of plastic materials are full, to bring them to their Coach, who lives nearby. The Coach stores the bags, and those of other neighbours taking part in the scheme, until Yoyo can collect them. Yoyo takes them directly to a recycling factory, where plastic bottles are transformed into new, ready-to-use products! A water bottle becomes a toy, a pen or a new bottle. Each full bag earns the collector points, giving them discounts on sporting or cultural activities, and vouchers for businesses working in partnership with YoYo (shops, cinemas, football clubs).





NEW ZEALAND: PIONEERING THE CIRCULAR ECONOMY

In 2018, New Zealand ranked number one in the World Bank's Ease of Doing Business index. Regarding innovation, since 2000 the government has been developing strong initiatives aimed at promoting business R&D, and at improving the effectiveness of the public sector contribution. This dual culture of innovation and entrepreneurship, anchored in the "kiwi" mentality, is illustrated by many inspiring examples of startups within the circular economy. Here is a selection of these:

AVERTANA

produces raw materials from industrial waste, for a wide range of industrial uses (pigments for paint, linings, plastics, paper; nutrients for animal feed and fertilizer, drinking water treatment, paper manufacturing, and construction materials including cement and wall panels).



MINT INNOVATION

develops bio-metallurgical processes (efficient and environmentally-friendly methods of recuperating precious metals from existing sources) which use microbes to collect value from residual gases, while also limiting the impact on the environment. The metals which undergo this recuperation process are extracted from industrial waste such as mining residue, electronic waste, toxic metal scraps, and recovered heavy metals.



CLEAR SITE DEMOLITION

deconstructs, rather than demolishes, houses. Wood, historic features, and accessories are recovered, reused, used for other purposes or recycled, allowing for a significant reduction in the amount of demolition waste. In order to find uses for materials recovered in this way, Clearsite Demolition has developed partnerships with flooring specialists, furniture manufacturers, recycling warehouses, framework recyclers and an NGO, Habitat for Humanity. Profits from the resale of recovered materials go to the client, which makes this solution more financially advantageous than traditional demolition.



INNOCENT PACKAGING

Packaging produces plant-based disposable food packaging. It is the first and only company in Australasia to produce only plant-based packaging.

Since 2013, the company has been supplying a wide range of plant-based compostable alternatives to packaging from petrochemical products, reducing the amount of products that end up at landfill sites. Plates and takeaway containers are manufactured from wheat straw, a process which creates muddy waste water. This is then used in the company's worm farm. Tumblers, bowls and lids are lined with poly-lactic acid (corn starch), which produces 80% less greenhouse gases than traditional plastic linings.

To ensure that vegetable packaging at the end of its life is diverted from the sorting chain for household waste, which terminates at landfill sites, the company works with 11 commercial composting sites throughout New Zealand to compost its packaging. It is also associated with 50 cafés across Auckland, creating the first city-level public collection site for composting, where food and compostable packaging are collected.





JAPAN'S EXEMPLARITY WITH REGARD TO CONSTRUCTION MATERIAL RECYCLING

Due to Japan's exposure to seismic risk and limited access to natural resources, the country upholds very strict regulations with regard to construction and deconstruction. In 1994 the Japanese government adopted a pioneering attitude to recycling of construction/deconstruction materials when it implemented its Action Plan on Dealing with Construction Byproducts, which effectively enforced recycling of construction waste across the country to the extent that 84 to 99% of construction/deconstruction waste was recycled in Japan in 2012 (cement, mud, wood, etc.).

Under this legal framework, materials used on a construction site must be sorted and referenced, each site is required to produce a sorting report to account for the composition of outgoing waste. Construction companies are required by law to reuse or recycle their waste themselves if no recycling facility exists within 50km of the site. These facilities display similar equipment as their European counterparts (crushers, screens, etc.). Furthermore, the government is also required to reuse construction/deconstruction waste and to encourage private markets to make use of this waste too. Numerous guides have been designed to help construction professionals navigate these regulations, which are taught in schools and enforced by heavy financial sanctions in the event of illegal dumping. Japan's strategy in the matter is aligned with the 3R philosophy (Reduce, Reuse, Recycle) adopted by the country in 2004 which it also promotes to developing Asian countries.



In the Japanese city of Kamikatsu, the bar of Kamikatz Public House is made entirely from recycled materials.



What if the island's economic intelligence consisted in creating value rather than products?

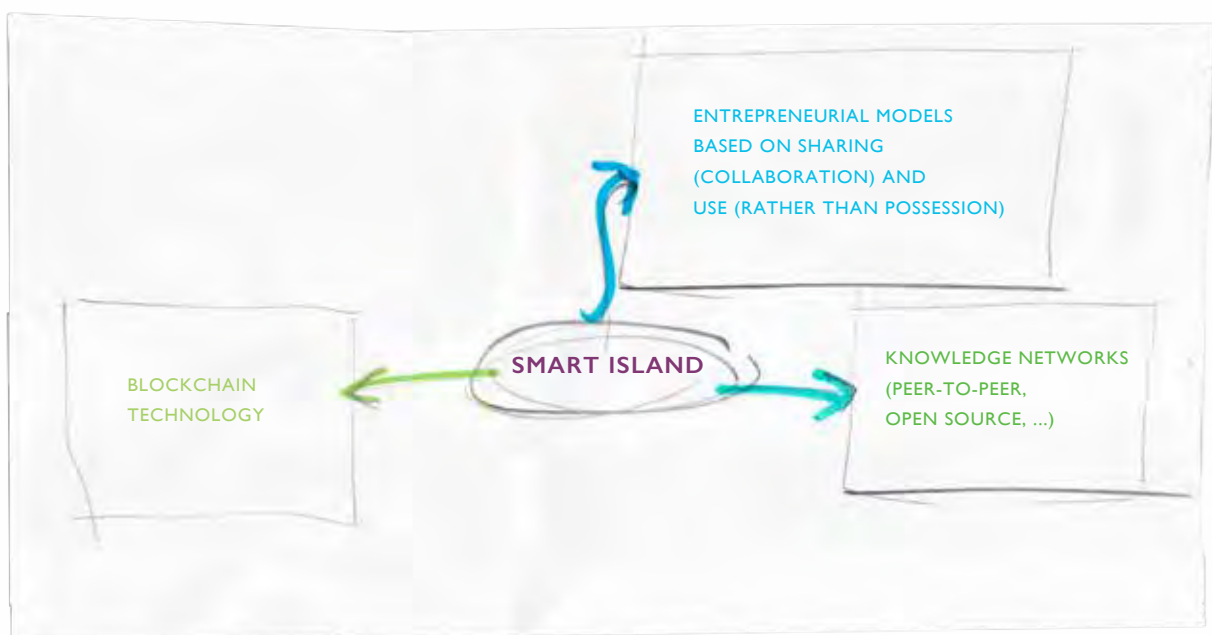
2.3 SMART ISLAND

What if economic intelligence on the island consisted of creating value rather than products? As a 'Smart Island', Mauritius would undergo the transition from a Product In – Trash Out (PITO) model to a Data In – Data Out (DIDO) model. Rather than selling products or labour the island would focus on selling know-how, and skills with significant added value. This approach includes:

- Replacing the production of goods with the sale of a use (service contract) or sharing (collaborative platform)
- Creating networks for transmitting knowledge, and promoting interactions between the people in these networks
- Exporting value without material production: fees, royalties, licences, franchising

The benefits that can be expected from a less material approach to economic development are many:

- Better organization, the ability to collaborate in different ways in order to vary models, and increased capacity to adapt
- Opening and participating in global knowledge networks, showcasing the country's capacities
- Freedom from geographical boundaries, and integration into a multi-polar world system and the communities therein
- Limiting consumption, and the extraction of primary and secondary resources



2.3.1 Entrepreneurial models based on sharing (collaboration) and use (rather than possession)

Due to material and environmental constraints, many innovative companies have moved from selling products to selling services.

EQUIPMENT

In 2017, imports of household appliances reached \$17m (including \$354K of re-exports)

Limiting consumption of equipment, while generating value through the use of equipment

Lokéo LOUEZ
PROFITEZ
INNOVEZ



Lokéo is a subsidiary of the HTM group (the parent company of the household appliances company Boulanger). Since 2009, it has offered long-term rental deals on household appliances, image and sound products as well as microphones and multimedia products. This entrepreneurial venture is born from Frédéric Caymaris Moulin's conviction that renting equipment would become one of the major purchasing techniques of the future.

Lokéo's clients can rent products for the length of time that suits them best – between six months and five years. For the duration of the contract, clients also benefit from the complementary services offered by the company: home installation, advice, repairs, even help with IT products from specialized coaches. Since there is no option to purchase products, at the end of the contract all products are recuperated, reconditioned, and re-rented or recycled if necessary. Due to the absence of an initial investment (which also leaves clients more disposable income) this system promotes the purchase of superior quality, more long-lasting products. The re-use of products, and the maintenance services and handling included in rental packages also extend the life expectancy of these products, and the rental system removes incentives for programmed obsolescence.

In 2015, the start-up had a turnover of 3 million euros. Currently, Lokéo has 66 collaborators, has rented out more than 72,000 products, and reconditioned 86% of its products. This model, which is still a minority within the HTM group, has demonstrated growth and high potential ever since it was launched.

ENERGY

Getting paid for better energy performance

ESCOs (Energy Services Companies) offer integrated energy services, including programs such as energy contractualization, management of demand, and lower-cost planning. Companies guarantee a reduction in consumption and the maintenance of a lower-cost service, and their remuneration is directly linked to the reduction of these costs. They also finance energy reduction operations, and sign energy performance contracts.

Philips Lighting has signed a 'performance' contract with Amsterdam Airport, with the renovation of the airport's lighting being entirely financed by energy savings.



«We do not sell lamps, but light. We offer a lighting service in the form of a performance contract to reduce energy consumption and the rate of breakdown by monitoring buildings' use. This has completely transformed our models. Before, we sent products to our clients hoping to sell them more as soon as possible. Now, because products remain our property, and need to function for as long as possible, we make them in a more modular way, so that it will be easier to take them apart and repair them, or if necessary, upgrade them as part of a circular initiative.»

François Darsy, Office and Industry Marketer, Philips Lighting (Signify)

MOBILITY

Selling kilometers travelled rather than tires

Michelin is without a doubt the most iconic example of a company that has moved from an economy of selling products, to a functional economy based on selling services. In one of its offers, rather than selling the tire, Michelin sells the use of the tire, and takes responsibility for its maintenance in order to increase its life expectancy. The company provides inflation and retreading services, as well as giving advice to drivers. The life expectancy of products is thereby increased, and fuel costs are reduced (which benefits both customers and the environment), and Michelin also increases its profit margins by selling expertise in the use of its products, and associated services.



Promoting mobility and limiting fuel needs

The Finnish startup MaaS Global (MobilityAsA Service) is a pioneer in the field. Using the concept of multi-modality, it has developed an impressive application called **Whim**. On your smartphone, the application will tell you the best route to take to get from point A to point B, using various modes of transport including public and/or private. Using information gathered from multiple sources, and artificial intelligence capable of calculating multiple possibilities in record time, this application is effecting a profound transformation of mobility. Whim also acts as a payment intermediary, providing access to the full range of modes of transport from a single interface, although it does not manage payment directly with any of them.



Extending a service developed for employees of a large company to all island residents

Initially developed for employees of Zeop (a communications network), **RunDrive** is a 100% community-based car-sharing service on the island of La Réunion. Faced with ever-increasing traffic jams on the island's roads, RunDrive aims to tackle ESS, or 'Empty Seat Syndrome.'

The principle is simple: drivers post the journeys they want to share directly to the site, and passengers can reserve and pay directly online. The platform takes a small share of the fee for its operating costs. An app is also available.

RunDrive was launched in February 2017 by ZEOP, an historic provider of very high-speed fiber optic internet services on Reunion Island. More than 3700 people are now subscribed to its Facebook page.



CHEMICALS

Renting consumables: gaining added value from a durable product linked to a service

Safechem, a subsidiary of Dow Chemical in Germany, has developed the Safetainer system of recuperating chlorinated solvents by avoiding loss through evaporation. These solvents are then recycled, before being returned to clients within the framework of rental contracts. Savings achieved through this process can be as much as 92%. Within five years, Safechem's market share has passed from 6% to 50% (Source: <http://economiedefonctionnalite.fr/en-pratique/7-safechem/>).

As a response to strict regulations (REACH), many large industrial chemical companies such as Dow Chemical, as well as Ashland, Castrol, and SafetyKleen, are rethinking their offers, and providing clients with advice services in order to use their products in a more efficient manner.



FOOD

Creating a network of consumers and producers



La Ruche qui dit Oui ! (The Hive that says Yes!) is an online platform that facilitates direct sales from local producers to consumers, who meet regularly in pop-up markets, or "Ruches" (Hives). The platform started in 2011, and now organises almost 1000 "Hives" across Europe, bringing together 5000 producers and 160 000 members. Through its ordering system, and through fair remuneration, the platform is helping to build a more sustainable food system.



HOSPITALITY

“ Local as a Service ” (LaaS): an opportunity for the tourism sector

A new market known as “ **Local as a Service** ” (LaaS) is emerging, which aims to bring together large numbers of local goods and service providers on the same digital platform (this can be offered as a complement to accommodation, or as a service to local communities) in the form of a “local package”, with payment models ranging from “à la carte” to fixed packages and subscriptions.

Within the hotel industry a LaaS model can take the form of an online platform providing access to a multitude of local providers (in leisure activities, culture, heritage, events, transport/mobility, local products) either for pre-booking or on-site (via an app).

Actors in the tourism sector have recently launched several initiatives along these lines. Expedia is taking on a new role as a “local expert”, while Airbnb is branching out into “local experiences”, (travel platforms, restaurant reservation, and the reservation of activities such as longboarding on the river Seine in Paris), and Accor Group’s Mercure chain of hotels has launched a “Local Stories” initiative.





SEOUL AND THE SHARING CITY MODEL: CONSUMING WITHOUT OWNING

Seoul, a megacity of 10 million inhabitants, has set out to become a sharing city by creating an online platform dedicated to promoting and facilitating shared use of both public and private resources.

Elected in 2011, Seoul's mayor Park Won-Soon launched the Sharing City Seoul initiative in 2012 to make Korea's capital city a hub of circular and functional economy and find solutions to the city's challenges, from chronic traffic congestion, air pollution to social isolation. For centuries, traditional "poomasi" (« exchange of labour ») was a pillar of Korean society. Sharing City Seoul invites the citizens of Seoul to reconnect with this tradition and gain access to assets without owning them. This is made possible via the ShareHub online platform, which brings together over 50 sharing companies and organizations operating activities as varied as car pooling, clothes retail or rental services, daily tools rental services, etc.

Sharing City Seoul is effectively laying the foundations for a new economic model based on positive social values, allowing participating organizations and citizens to reduce their expenses with the help of this easily accessible online platform, in a city where 97% of people have access to high speed internet. Sharing companies involved in Sharing City Seoul have grown rapidly and have drawn international attention to this success story, spurring similar initiatives elsewhere: in 2013, 18 American cities signed a pledge to become Shareable Cities.



<https://bit.ly/2KRQoUY>

2.3.2 Knowledge networks (peer-to-peer, open source, ...)

Networks and peer-to-peer communities create common value through knowledge-sharing. Bringing together talent and production within these open communities leads to a change in perspective, since members can fill in the gaps in their peers' knowledge. This approach seems particularly pertinent for an island, where access to R&D expertise and skills may be more limited.

ONLINE

Crowdsourcing R&D

Founded in Canada, **Sensorica** <http://www.sensorica.co/> is an open source 'community laboratory'. Contributors create scientific content and products, which are then rated by peers. Companies and entrepreneurs are free to use this knowledge, and some of the profits from this resource are returned to the contributors.



Sharing the knowledge required to manufacture all kinds of objects via an open source design platform

Open Source Ecology is a network of engineers and farmers who have developed a set of open source blueprints for the fabrication of the 50 most important industrial machines required for modern civilization to exist: windmills, ovens, bulldozers, combine harvesters, sawmills, etc.



Computer programming courses for unemployed youth and people in the process of changing careers

Simplon offers free, intensive professional training to help the unemployed become developers and data artisans (working with websites, mobile applications, integrators, digital referents, and e-commerce). Simplon has created an active teaching method where the student is confronted with real scenarios in both individual and group contexts. Group work is a central element of the apprenticeship, and the student is helped and assessed by his or her peers.

The Simplon adventure began in 2013, when the company was launched by Frédéric Bardeau, Andrei Vladescu-Olt and Erwan Kezzar. Inspired by the bootcamps which were springing up all around the mythical Silicon Valley, Simplon's founders set out to create a similar training facility in France which would be more inclusive of women and of people from different backgrounds and countries, as well as free of cost. Once the company's Montreuil headquarters had been bought and refurbished, the first class of 30 people of 17 different nationalities arrived that October. In 2014, Simplon branched out to other locations in France, before extending its model to the international level. A center was opened in Romania in 2014, with Brussels, Lebanon, the Ivory Coast, and South Africa following suit. As part of the social and solidarity economy, Simplon is focused on its social mission, and has social impact indicators which allow the company to monitor the direct and indirect results of its work.



A 6 mois après la sortie de la formation

77%

Sorties positives

79%

dont Emplois (CDI, CDD, contrats aidés ou de prof.)

16%

dont Freelances, auto-entrepreneurs et créateurs d'entreprises

21%

dont Poursuite d'études et stages

IN REAL LIFE

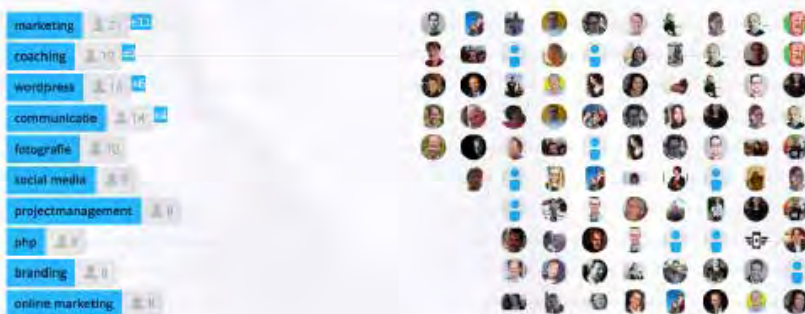
Developing pro-innovation spaces – “CONNECTING AND EMPOWERING YOU TO EXCEL”

Seats2meet specializes in enriching “social capital” through its “Serendipity Machine” application. Seats2meet is a network of innovative spaces around the world which combine incubators, co-working spaces and events. S2M is based on a simple idea: people who come to co-work agree to share their knowledge, and in exchange they pay nothing for the space. These spaces are financed by companies who pay for the rental of the meeting rooms. The ‘Serendipity Machine’ application connects users of these spaces. In 2018, the network listed 2350 spaces in 208 cities across 40 countries.



An abundance of knowledge is available for you

Sharing knowledge is cool! You will have unexpected relevant encounters. People you do not know, but whom are relevant to you and your future. You will find support from peers. Below you can find all the available knowledge that can help you arrange your workspace.



2.3.3 Blockchain technology

The example of local energy micro-networks

With the explosion of cyber currencies, one technology in particular has caught the attention of banks and companies across all sectors, particularly those specialized in the production of green energy: blockchain technology.

Cyber currencies are based on a kind of “public accounts book”, in which every transaction is recorded in order to rule out the possibility of embezzlement. This secure, decentralized database allows for the creation of ‘smart contracts’, programs which automatically trigger actions under certain conditions. This protocol permits the construction of all kinds of services: decentralized transactions, electronic voting, future systems of electronic certification, stock exchange purchases, and... the exchange and production of electricity.

It is therefore possible to bring together residents in a district on a blockchain (whether or not it is associated with an electronic currency) to allow them to produce renewable energy. They can then exchange electricity at cost price, according to their needs. These exchanges are regulated by ‘smart contracts’, which certify that those who request access to energy have the right to it, and those who provide it have the capacity to do so. This kind of system helps to limit use of the national energy network, since it uses electricity produced by residents’ solar panels instead.

In New York, some sixty residents in a district share green energy through the **Brooklyn Microgrid project**. Since 2016, residents have been producing solar energy via photovoltaic panels, in order to exchange and re-sell it through the P2P blockchain. This microgrid (a micro-network of local energy) is supported by the State of New York and Siemens, and was developed by TransActive Grid. The cooperative brings together two companies, one specialized in the development of energy networks, the other in Bitcoin. Its aim is to limit as much as possible residents’ use of electricity from traditional providers. The money generated by the sale of energy remains within the community, and loss through leakage during transport is also reduced. On the Ethereum platform, energy exchanges in real time are managed by a smart contract, with no human or economic intermediary, and according to the quantity of electricity produced and residents’ needs.

“By going through a local provider, who turns out to be my neighbor on the other side of the street, the money remains in the community, and the benefits to the environment are tangible. Moreover, when I buy green energy from my neighbor, I encourage other neighbours to install solar panels on their roofs”, **Bob Robert Sauchelli**, a Brooklyn resident, told French daily newspaper *Les Échos* in 2016.



Brooklyn Microgrid, a project for green energy-sharing via P2P, has been operational since 2016

Credit : Brooklyn Microgrid

Brooklyn Microgrid has become an icon of green energy-sharing through blockchain technology. The project has inspired many similar initiatives (40 in the United States alone), contributing to the gradual democratization of green energy use in the United States and across the world.

The Sunchain startup's ambition is to "circulate solar energy on public electricity distribution networks" by creating "new models for the production and consumption of green and intelligent energy." To this end, it has created its own 'private blockchain' in order to promote 'collective self-consumption' and energy exchanges between buildings. "Rather than selling the excess of energy produced by a building, it is more intelligent to transfer it to another building. That way, at the level of an eco-district, self-consumption is pooled, no matter where the solar panels are installed", the company states on its website.

Blockchain technology is a valuable tool for measuring, storing and certifying information on different energy flows (green and non-green) without using an external provider, and it also allows for the release of local energy deposits, and enhances energy self-sufficiency in cities and on islands.

Source: Fabien Soye

APPENDIX: METHODOLOGICAL NOTE

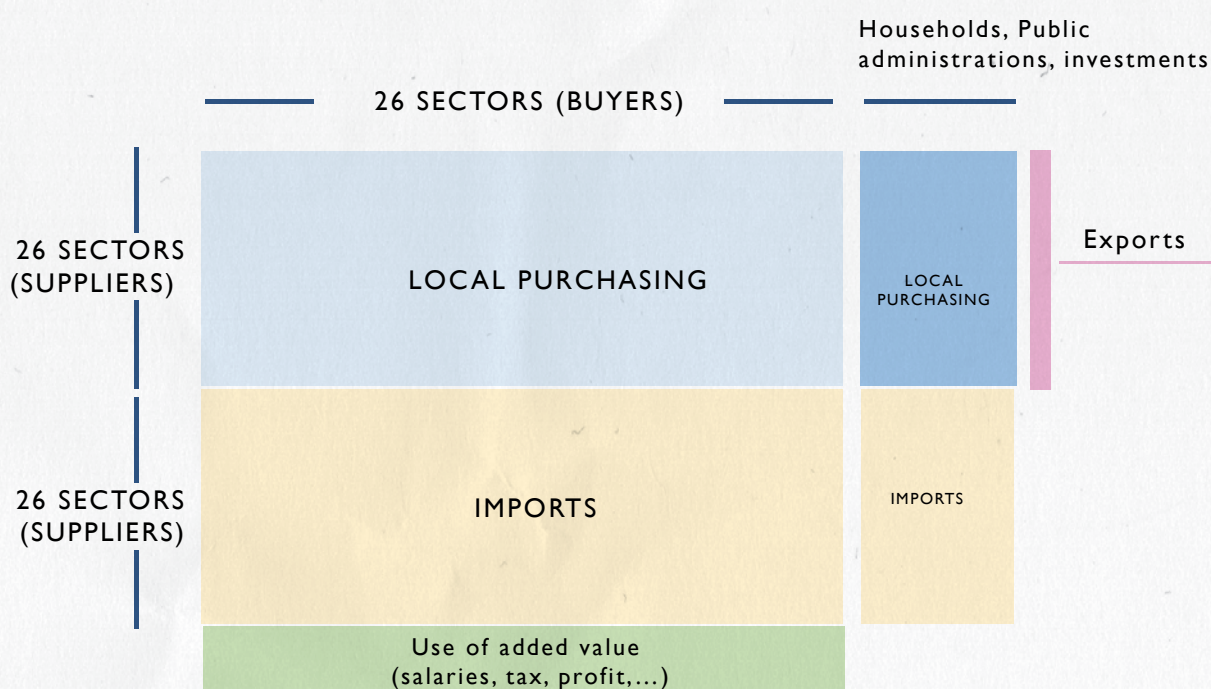
How is the local multiplier effect (or pinball effect) measured?

The local multiplier effect reflects a country's capacity to durably circulate wealth injected from abroad within its economy. A country's income is the product of its external income (exports, capital and labour revenues) and its local multiplier effect. As with a game of pinball, scoring highly requires that a player maintain the ball in the game as long as possible and circulate it with the help of impulse mechanisms that maintain and direct it (away from the fatal exit), so as to increase the score and win extra-balls (or credits) which in turn allow to extend the game and increase the final score. The local multiplier effect works in the exact same way: external income enters local economic circuits, circulates within them (in particular if the economy is diverse and features impulse mechanisms such as banking credit), generates local income and hence further cycles of potential spending via household or public-sector expenditure and investments (extra-balls).

Creating an accurate model to represent these mechanisms is a complex task, as the model must illustrate incoming, outgoing and circulating flows between all business and non-business entities on the island. The theoretical framework known as "Input-Output tables" (or IO tables), which are used in a number of countries to establish national accounting, allows to reproduce these flows sector by sector (the heart of any input-output table is made of a rectangular table tracing the full range of exchanges between buying sectors and supplier sectors). To date, two statistical sources provide IO tables for Mauritius. Firstly, Stats Mauritius whose latest version of Mauritius' IO table was established for the year 2007 and is now outdated. Moreover, in this IO table, incoming-outgoing flows to and from foreign countries are not broken down per sector, therefore it does not allow to establish a model of Mauritius' input-output flows. The EORA database (which covers 26 sectors) is established per country, including Mauritius, based on the WTO's international trade statistics as well as national statistics, offering a more recent IO table for the year 2015. However, this IO table features a number of incoherencies, in particular due to the fact that re-exports / re-imports are included in EORA's model though these flows do not actually enter the island's national economic circuits, which influences a number of figures.

For this reason, we set out to establish our own ad hoc IO table for Mauritius for the year 2015, the year for which the most macro-economic data was available from official sources. To this end, we created a hybrid model based on EORA's IO table (making use in particular of EORA's estimated average behaviors of sectors, households as well as the public sector) which we enhanced and balanced out using data from Stats Mauritius such as sectorial statistics (employment, production, weight and distribution of added value per sector), detailed import-export data per product (to which we subtracted re-export / re-import data) as well as statistics concerning household income/spending, investments and government income/spending. The IO table we have established with this method displays an error margin (with regard to its capacity to accurately reproduce Mauritius' major macro-economic flows) of less than 5%.

Table Input-Output - Mauritius 2015



This IO table provides an accurate and comprehensive view of Mauritius' economic flows for the year 2015. However, it provides only a snapshot of these flows, failing to identify certain of the island's economic dynamics, in particular when it comes to understanding the trajectory of foreign wealth injected into Mauritius and assessing the successive cycles of spending it generates as this wealth circulates within the island's economy in a ripple effect. For this reason, it was necessary to break down this trajectory and analyze the creation of income every step of the way.

Our first task was to analyze the full range of economic flows entering the island from exports and various kinds of income (labour, capital, international aid). A comprehensive snapshot of the island's international income was established using the island's balance of payments (excluding offshore flows), tourism statistics (including spending from tourism) and a detailed analysis of exports (per product). Secondly, the impacts of these flows of income were broken down at each cycle of spending generated within the island's economy. An IO table provides an overview of all "production functions" for each sector in addition to average spending behaviors for households and the public sector, as well as an average breakdown of investments. Consequently, it allows to simulate a company's standard behavior as well as that of its supply chain, to predict the proportion of additional production

generated which will create more income and to simulate spending and investment that this additional income will induce and then measure the ripple effect, thus providing an estimate of the amount of additional income which can then be reinjected into the island's economic circuits... and so on and so forth until the level of income reaches 0. In a year, it is estimated that international income entering Mauritius goes through 15 such spending cycles as it circulates within the island's economy, requiring approximately 80 steps of analysis to complete such a study. A similar study was conducted for the years 1995, 2000, 2005 and 2010 to follow the evolution of the multiplier effect.

STATISTICAL SOURCES USED IN THIS STUDY

STATS MAURITIUS

Digest - National Accounts of Mauritius 2015
Digest of External Trade Statistics 2015
Detailed Trade Data by HS/Country 2007 – 2015
Household Budget Survey 2012 - 2017
Digest of International Travel and Tourism 2015

DIGEST OF LABOUR STATISTICS 2015

Key Indicators of the Labour Market (2011- 2016)
Digest of Public Finance Statistics 2015-2016
Input and Output Tables (2007)
<http://statsmauritius.govmu.org/>

BANK OF MAURITIUS

Balance of Payments - Four quarters and Year 2015
www.bom.mu

WORLD BANK

World Development Indicators (WDI)
World Bank national accounts data
<https://data.worldbank.org/indicator/>

INTERNATIONAL MONETARY FUND (IMF)

World Economic Outlook (WEO) database
Balance of Payments Statistics Yearbook, BOPS
www.imf.org/en/Data

EORA GLOBAL SUPPLY CHAIN DATABASE

Eora National IO Tables 2015
Full EORA Multi-region input-output table (MRIO) database
<http://worldmrrio.com/>

