Social cost-benefit analysis of tobacco control policies in the Netherlands

Maatschappelijke kosten baten analyse van tabaksontmoediging

Maastricht University

Rijksinstituut voor Volksgezondheid en Milieu
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Voorwoord

Tabaksverslaving leidt tot grote gezondheidsrisico's en jaarlijks sterven er meer dan 20.000 mensen aan de gevolgen van roken en meeroken. Dat is inmiddels bekend. Maar wat zijn nu werkelijk de kosten, maar ook de baten die roken voor Nederland met zich meebrengt? Voor Nederland als totaal, maar ook voor de diverse stakeholders zoals de roker zelf, de overheid, de gezondheidszorg en de werkgever. En misschien wel de belangrijkste vraag: hoe ontwikkelen deze kosten en baten zich wanneer het aantal rokers afneemt?

Met deze Maatschappelijke Kosten Baten Analyse (MKBA) proberen de onderzoekers een rationele impuls te geven aan de opvattingen over de kosten en baten van tabaksontmoediging. Daarbij wordt verder gekeken dan alleen de kosten en baten in de gezondheidszorg. In de analyse is gekozen voor een breder economisch en maatschappelijk perspectief. Dat wil zeggen dat álle van enige betekenis zijnde kosten en baten meegewogen worden in het streven naar een rookvrije samenleving. Ter illustratie: ook de economische baten van een productievere bevolking en de kosten van het verloren gaan van het 'consumentensurplus' worden meegenomen. Op deze manier is -volgens de meest recente wetenschappelijke richtlijnen voor het maken van een MKBA- een zo compleet mogelijk beeld geschetst.

Op zichzelf kun je je afvragen of het wel zinvol is bij roken naar het consumentensurplus te kijken. Het consumentensurplus is de waarde die een consument bereid is méér te betalen voor een bepaald product dan de marktprijs. Deze economische term is bij normale producten waar vrijwillige keuze een rol speelt een belangrijk micro-economisch principe. Tabak is sterk verslavend en dan is er eerder sprake van consumptiedwang dan van een consumentensurplus in de zin van een specifieke en vrijwillige keuze uit alternatieven. Maar om in deze MKBA een zo compleet mogelijk beeld te krijgen is consumentensurplus toch door de onderzoekers als variabele meegenomen.

De resultaten van de MKBA zijn verrassend te noemen. De uitgewerkte scenario's laten namelijk zien dat er mogelijkheden zijn om het aantal rokers in Nederland met 14,2 procentpunt te laten dalen de komende 35 jaar. Dat is een beter resultaat dan te verwachten is met voortzetting van het huidige beleid waarbij het aantal rokers slechts met 2,3 procentpunt daalt.

Investeren in gezondheid blijkt daarbij in de meeste doorgerekende scenario's niet alleen goed voor de gezondheid zelf, maar ook boven verwachting goed te zijn voor de belastinginkomsten, zeker wanneer gewerkt wordt met accijnsverhogingen voor tabak. Wanneer het consumentensurplus buiten beschouwing wordt gelaten, zijn deze uitkomsten zelfs nóg positiever.

Vanaf het begin is het uitgangspunt geweest dat een MKBA over dit onderwerp van hoge kwaliteit en zo objectief mogelijk moet zijn. Mede om die reden is het voorliggende onderzoek uitgevoerd door een combinatie van toonaangevende wetenschappelijke instellingen (de Universiteit Maastricht, het Rijksinstituut voor Volksgezondheid en Milieu en het Trimbos Instituut). Bovendien heeft zowel een klankbordgroep als een adviesraad van deskundigen het proces begeleid en zijn nationale én internationale experts gevraagd het rapport te beoordelen en waar nodig te becommentariëren.

Dat heeft tot een hoogwaardig rapport geleid met verrassende en belangrijke uitkomsten. En een rapport dat een stap verder gaat dan eerdere (ook internationale) onderzoeken op het gebied van kosten en baten van tabaksontmoediging. Ik hoop dat dit rapport een belangrijke rol zal gaan spelen in het maatschappelijke debat over de noodzaak van tabaksontmoediging, in Nederland en daarbuiten.

Paul Schnabel

Voorzitter adviesraad

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Samenvatting

Belangrijkste bevindingen:

In Nederland rookt 23% van de populatie 15 jaar of ouder (19,8% vanaf 0-100 jaar, waarop de berekeningen in deze studie zijn gebaseerd). Bij een gelijkblijvend overheidsbeleid (zonder verdere intensiveringen) daalt de prevalentie van roken met 2,3 procentpunt de komende 35 jaar. In de alternatieve scenario's hier gepresenteerd kan de prevalentie met 14,2 procentpunt dalen tot 5,6% in 2050 door een verdere intensivering van tabaksontmoedigingsbeleid. Alle onderzochte scenario's resulteren in een positief saldo, al worden de baten bij verschillende stakeholders behaald, afhankelijk van het scenario. In scenario's waarin vooral de prevalentie daalt, als gevolg van massa media campagnes, zijn de baten het grootst voor de consumenten (verhoging van het aantal QALYs) en voor de werkgevers (daling in de productiviteitsverliezen). In scenario's waarin de accijnzen stijgen, zijn de baten het grootst voor de overheid. De scenario's waarin zowel een maatregelenpakket ingevoerd wordt en een accijnsverhoging van 5% of 10% per jaar, resulteren in zowel baten voor de consumenten en werkgevers als in de accijnsinkomsten voor de overheid.

Inleiding

In 2012 rookten ongeveer 3,9 miljoen mensen in Nederland. Roken is de belangrijkste veroorzaker van onder andere hart- en vaatziekten, longkanker, en COPD. Naast de negatieve invloed van roken op de gezondheid veroorzaakt roken ook een economische last voor de samenleving. Zo werd er in 2010 in Nederland €2,8 miljard uitgegeven aan aandoeningen direct veroorzaakt door roken. Dit rapport beschrijft een studie naar de maatschappelijke kosten en baten van roken gerelateerde interventies, een zogenoemde maatschappelijke kosten-baten analyse (MKBA). Hierbij worden op macro-economisch niveau alle relevante kosten en baten van roken in beeld gebracht en uitgedrukt in monetaire eenheden (geld). Een MKBA conform de richtlijnen van het SEO onderzoeksinstituut en het Centraal Plan Bureau kan een bijdrage leveren aan de beleidsvoorbereiding en de besluitvorming op het terrein van volksgezondheid en zorg. Deze studie is uitgevoerd in opdracht van Alliantie Nederland Rookvrij (ANR). KWF Kankerbestrijding heeft het onderzoek gefinancierd.

Doel

Het doel van dit rapport is om verschillende rook gerelateerde beleidsscenario's met elkaar te vergelijken, te weten:

1) continuering van het beleid in het jaar 2015 zonder verdere veranderingen/intensiveringen in de toekomst, ook wel het nul-alternatief genoemd;
2) een jaarlijkse accijnsverhoging van 5%;
3) een jaarlijkse accijnsverhoging van 10%;
4) (jaarlijkse) massa media campagnes;
5) het invoeren van een pakket maatregelen zoals gedefinieerd door de WHO (rookverboden, stoppen met roken hulp, massa-mediale campagnes, reclameverbod - MPOWER) inclusief een jaarlijkse accijnsverhoging van 5%;
6) het invoeren van een pakket maatregelen zoals gedefinieerd door de WHO (rookverboden, stoppen met roken hulp, massa-mediale campagnes, reclameverbod - MPOWER) inclusief een jaarlijkse accijnsverhoging van 10%;
7) een situatie waarin Nederland rookvrij is over 35 jaar (<5% prevalentie);
8) een situatie waarin men niet meer begint met roken vanaf 2017.

Om de effecten van de verschillende interventies goed in kaart te brengen is gekozen voor een tijdshorizon van 35 jaar (in scenario 7 & 8 zijn geen interventies overgenomen). Dit betekent dat alle kosten en baten doorgerekend zijn tot het jaar 2050. In dit onderzoek zijn de prevalentie van roken in de samenleving in kaart gebracht evenals de kosten en de baten van roken in monetaire eenheden per stakeholder (bijv. consumenten, werknemers, en de overheid).

Methode

In een MKBA worden achtereenvolgens de volgende stappen doorlopen:

1) Probleemanalyse;
2) Nul-alternatief (kosten en baten bij gelijkblijvend beleid);
3) Omschrijven van de onderscheiden maatregelen;
4) Bepalen van de kosten van de betreffende maatregelen ten opzichte van het nul-alternatief;
5) Bepalen van de baten van de maatregel ten opzichte van het nul-alternatief;
6) Presenteren van een overzicht van de kosten en baten per maatregel (saldo, maar ook overzicht wie betaalt en wie ontvangt, en verdelingseffecten);
7) Varianten en onzekerheidsanalyses (o.a. gevoeligheid voor aannamen, PM posten);
8) Presenteren en interpreteren van het geheel.

Voor deze MKBA is gebruik gemaakt van het Chronisch ziekten Model (CZM) van het Rijksinstituut voor Volksgezondheid en Milieu (RIVM), het SimSmoke model en een speciaal ontwikkeld Excel model. Het CZM is een Markov-model[1] dat gebruikt is om de populatieaantallen (mortaliteit, morbiditeit), de kosten binnen de gezondheidszorg, en de kwaliteit van leven te berekenen. De effectiviteit van de verschillende maatregelen op de prevalentie van roken en de gezondheidsrisico's zijn doorgerekend m.b.v. het SimSmoke-model. Beide modellen gecombineerd schatten de kosten voor de gezondheidszorg en het aantal gezonde levensjaren, uitgedrukt in quality adjusted life-years (QALYs). Om vervolgens andere maatschappelijke kosten te berekenen (bijv. productiviteitsverliezen) is een Excel model ontwikkeld. Er is gewerkt met een discontovoet van 3% voor zowel kosten als baten. Voor het nul-alternatief zijn de verdisconteerde en niet-verdisconteerde resultaten gepresenteerd. Voor de vergelijking tussen de scenario's zijn de verdisconteerde waarden gebruikt volgens de richtlijnen voor MKBA's. De kosten en baten zijn in kaart gebracht a.d.h.v. de volgende categorieën: het aantal en de waarde van de QALYs (gewaardeerd met verschillende QALY-waardes (€20.000 - €200.000 per QALY), rook-gerelateerde zorgkosten; andere zorgkosten, waarde consumentensurplus, overheidsinkomsten, kosten van brandschade, kosten voor het milieu, absenteïsme/presenteïsme (directe productiviteitsverliezen), overdracht belastingen en premies, bijstand/AOW/pensioen, absenteïsme/presenteïsme (indirecte productiviteitsverliezen), en de Interventiekosten (indien van toepassing). Het consumenten surplus is meegenomen in het model (conform richtlijn) maar is controversieel als het gaat om tabak, aangezien de keuze voor sigaretten niet (geheel) vrijwillig is. Er is immers sprake is van een verslaving. Het producenten surplus en de invloed van het beleid op de arbeidsmarkt zijn niet meegenomen in het model (conform richtlijn) omdat er niet direct wordt ingegrepen in de markt en veranderingen in deze sectoren op termijn enkel tot verdelingseffecten zullen leiden.

Om de validiteit van verschillende aannames in dit rapport te onderzoeken zijn diverse sensitiviteitsanalyses gedaan. Er is gerekend met verschillende waarden voor QALY's en verschillende effectiviteitsschattingen van massa media campagnes (enkelvoudige-sensitiviteitsanalyses). Daarnaast is er een probabilistische (meervoudige-) sensitiviteitsanalyse uitgevoerd om de impact van de onzekerheid rondom verschillende parameters te onderzoeken (bijv. populatieaantallen, de kans dat iemand begint/stopt met roken, of de gezondheidszorgkosten).

[1] Het Markov-model bestaat uit een beperkt aantal, elkaar uitsluitende gezondheidstoestanden (Markov-'states'). Hiertussen kan een theoretisch persoon switchen, bijvoorbeeld naar stadia van roken. Aan de Markov-'states' kennen we vervolgens een waardering toe (roken/niet roken, leven/dood, kwaliteit van leven, kosten, etc). Het switchen tussen 'states' is dan weergegeven door de kansen op bijvoorbeeld succesvol stoppen met roken of overlijden binnen een bepaalde tijdsperiode. De totale tijd dat een persoon in de afzonderlijke toestanden 'verblijft' is bepalend voor de te verwachten waarde van de verschillende strategieën, zoals levensverwachting, QALY of kosten.

Resultaten

Scenario 1: Het nul-alternatief

Dit is het scenario waarin het huidige overheidsbeleid (jaar 2015) wordt geëvalueerd met gelijkblijvend beleid zonder enige intensivering voor de komende 35 jaar. In dit scenario blijkt dat de prevalentie van roken daalt met 2,3 procentpunt tot 17,5% in 2050. Verder zullen de rook-gerelateerde zorgkosten toenemen van €8,3 miljard per jaar in 2015 tot €10,9 miljard per jaar in 2050 (niet-verdisconteerd), voornamelijk veroorzaakt doordat de populatie in omvang toeneemt. De waarde van het consumenten surplus zal licht afnemen en het aantal QALYs zal licht stijgen.

Scenario 2 & 3: Verhoging van accijnzen met 5% of 10% per jaar

In deze scenario's is doorgerekend wat de effecten zijn van 5% en 10% accijnsverhogingen per jaar op de maatschappij. In deze scenario's is de prijsverhoging vermenigvuldigd met de totale prijselasticiteit van de vraag (-0,4). De helft hiervan (prevalentie-elasticiteit: -0,2) is toegeschreven aan een daling van het aantal rokers. De andere helft (-0,2) wordt toegeschreven aan een daling in de verkoop van sigaretten doordat mensen minder gaan roken maar niet volledig stoppen. Om het effect op de prevalentie van roken te berekenen is daarom met een conservatieve prevalentie-elasticiteit van -0,2 gerekend. Daarnaast zwakt de prevalentie af over tijd. Door de complexiteit van de verschillende modellen is deze precieze afname moeilijk te kwantificeren (o.a. omdat de start/stop/terugval kansen elk jaar aangepast worden aan de prevalentie-elasticiteit en dit weer effect heeft op hiernavolgende jaren). In deze scenario's daalt de prevalentie van roken met respectievelijk 4,7 en 7,1 procentpunt, waardoor de uiteindelijke prevalentie daalt naar 15,1% en 12,7% in 2050. Verder stijgen voornamelijk de accijnsinkomsten. Bij een verhoging van de accijnzen van 5% per jaar stijgen de overheidsinkomsten uit accijns tot €4,3 miljard per jaar in 2050 en bij een verhoging van de accijnzen van 10% per jaar tot €23,5 miljard per jaar in 2050 ten opzichte van het nul-alternatief. De incrementele cumulatieve netto contante waarde (baten min de kosten berekend over de gehele tijdhorizon van 35 jaar t.o.v. het referentie scenario) is in deze scenario's respectievelijk €57 miljard en €179,4 miljard.

Scenario 4: Massa media campagne

In dit scenario is doorgerekend wat de gevolgen zijn van een jaarlijkse massa media (overheids-)campagne: dit is het geven van informatie/voorlichting via TV, radio, billboards etc. om roken te ontmoedigen. Uit (inter-)nationale literatuur blijkt dat de effectiviteit van een dergelijke campagne kan leiden tot een absolute daling in prevalentie (daling in het aantal rokers t.o.v. de totale populatie) van 0,4 tot 0,7 procentpunt per jaar. Hiermee kan berekend worden dat de maximale relatieve daling (daling in het aantal rokers t.o.v. het totaal aantal rokers) in prevalentie

6,5% is. In dit scenario gaan we uit van een relatieve daling in prevalentie van 1,2% per jaar. In sensitiviteitsanalyses is ook gekeken naar de effecten wanneer uitgegaan wordt van een relatieve daling in prevalentie van 3,55% en 6,5% per jaar. Op basis van campagnes uit 2008 is berekend dat de kosten in het eerste jaar €6,15 miljoen zijn, de kosten in de twee opvolgende jaren zijn: €4,62 miljoen. Het is verondersteld dat de campagne elke drie jaar vernieuwd zal worden om campagne-moeheid te voorkomen, waarbij het eerste jaar van de vernieuwing steeds €6,15 miljoen kost. In dit scenario daalt de prevalentie van roken met 7,3 procentpunt tot 12,5% in 2050. Verder dalen de accijnsinkomsten maar nemen zowel de gezondheidswinst als de arbeidsproductiviteit toe. De incrementele cumulatieve netto contante waarde is in dit scenario €2,2 miljard.

Scenario 5 & 6: Maatregelen WHO-verdrag met 5% en 10% accijns verhoging

In dit scenario zijn de gevolgen van de maatregelen bekeken zoals afgesproken in het WHO verdrag, het MPOWER pakket, inclusief een accijnsverhoging van 5% en 10%. Het MPOWER pakket bestaat uit rookverboden, stoppen met roken hulp, massa media campagnes, marketing beperkingen en accijnsverhogingen. Deze scenario's zijn een combinatie van informatie voorziening/voorlichting, verhoging van accijnzen, en wetgeving. De prevalentie van roken daalt in deze scenario's respectievelijk met 12,1 procentpunt (bij 5% accijnsverhoging) en 14,2 procentpunt (10% accijnsverhoging) tot een prevalentie van 7,7% en 5,6% in 2050. In deze scenario's is een sterke stijging in de accijnsinkomsten waarneembaar en nemen zowel de gezondheidswinst als de arbeidsproductiviteit toe. De incrementele cumulatieve netto contante waarde in deze scenario's is respectievelijk €52,9 miljard en €98,9 miljard.

Scenario 7: Rookvrije samenleving (prevalentie <5%)

In dit scenario zijn de kosten en baten teruggerekend vanaf een gewenst eindpunt, een prevalentie van roken van <5% in 2050. Verder zijn er geen veranderingen in het model aangebracht t.o.v. het nul-alternatief. In dit scenario stijgt de waarde van de QALYs sterk en dalen de accijnsinkomsten. Verder neemt de arbeidsproductiviteit toe. De incrementele cumulatieve netto contante waarde is in dit scenario €9,1 miljard.

Scenario 8: Niemand start meer met roken

In dit scenario zijn in het model de kansen dat iemand begint met roken op 0 gezet. Dit scenario laat de gevolgen voor de maatschappij zien wanneer niemand meer zou beginnen met roken vanaf het jaar 2017. Dit leidt tot een sterke stijging van de waarde van de QALYs en een daling van de accijnsinkomsten. Verder neemt de arbeidsproductiviteit toe. De prevalentie van roken daalt in dit scenario tot 4,8% in 2050. De incrementele cumulatieve netto contante waarde is in dit scenario

€10,3 miljard.

Conclusie

Met gelijkblijvend beleid, daalt de prevalentie van roken met 2,3 procentpunt de komende 35 jaar. De onderzochte alternatieve scenario's hebben de potentie om de prevalentie met 14,2 procentpunt te laten dalen (in scenario's 7 en 8 zelfs tot 17,4 procentpunt). Verder blijkt dat de interventiekosten in alle scenario's gering zijn over de gehele tijdshorizon en dat er in alle scenario's een positief saldo behaald wordt, ook op de lange termijn. Het is belangrijk te letten op de relatie tussen maatregel en effecten. Zo zorgen accijnsverhogingen in het algemeen voor extra accijnsinkomsten maar is er een lager effect op de prevalentie en ziektelast. Massa media campagnes, wanneer zelfstandig en als enig instrument gebruikt, hebben daarentegen een positief effect op de prevalentie maar een negatief effect op de accijnsinkomsten. De combinatie van deze maatregelen (scenario 5 & 6) heeft een gunstig effect op prevalentie én op de accijnsinkomsten. In scenario's waarin de prevalentie sterk daalt, ervaren vooral de consumenten (in de vorm van een stijging in het aantal QALYs) en werknemers (in de vorm van verminderde productiviteitsverliezen) de meeste baten.
In alle scenario's daalt het consumentensurplus. Indien het consumentensurplus niet zou worden meegenomen in de analyses vallen de resultaten positiever uit. Daarnaast is het belangrijk in gedachte te houden dat een verhoging van de accijnzen zou kunnen leiden tot verdringings- of grenseffecten, indien mensen over de grens tabak kopen. Een accijnsverhoging die afgestemd en doorgevoerd wordt in Europees verband, kan deze grenseffecten tegen gaan. Desalniettemin blijkt uit deze MKBA dat alle overheidsmaatregelen resulteren in een positief saldo voor de Nederlandse samenleving als geheel, zowel op korte als lange termijn. Een daling van de prevalentie van roken is zowel voordelig voor consumenten (verhoging QALYs) en werkgevers (daling in productiviteitsverliezen). Een stijging van de accijnzen resulteert in een verhoging van de overheidsinkomsten door accijnzen. De MKBA biedt daardoor belangrijke aanknopingspunten ten aanzien van het tabaksontmoedigingsbeleid in Nederland.

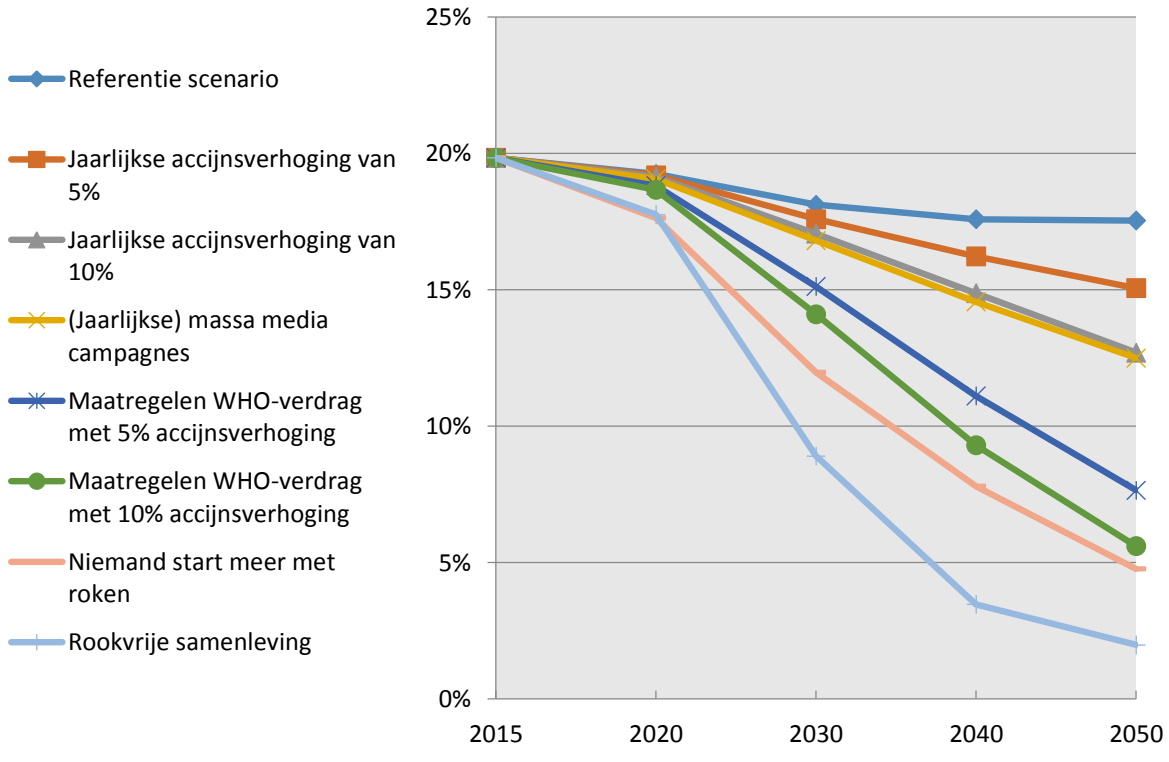
Leeswijzer

Na de inleiding (hoofdstuk 1) beschrijft hoofdstuk 2 de stappen die doorgaans genomen worden in een MKBA en zal er verder ingegaan worden op de drie gebruikte modellen. Vervolgens wordt het nul-alternatief besproken (hoofdstuk 3), de scenario's waarin de accijnzen met 5% en 10% per jaar verhoogd worden (hoofdstuk 4.1), het scenario waarin het effect van massa media campagnes wordt doorgerekend (hoofdstuk 4.2), de scenario's waarin een maatregelenpakket inclusief accijnsverhogingen van 5% en 10% per jaar worden doorgerekend (hoofdstuk 5), en de scenario's waarin uitgegaan wordt van een prevalentie van roken van <5% in 2050 en een scenario waarin

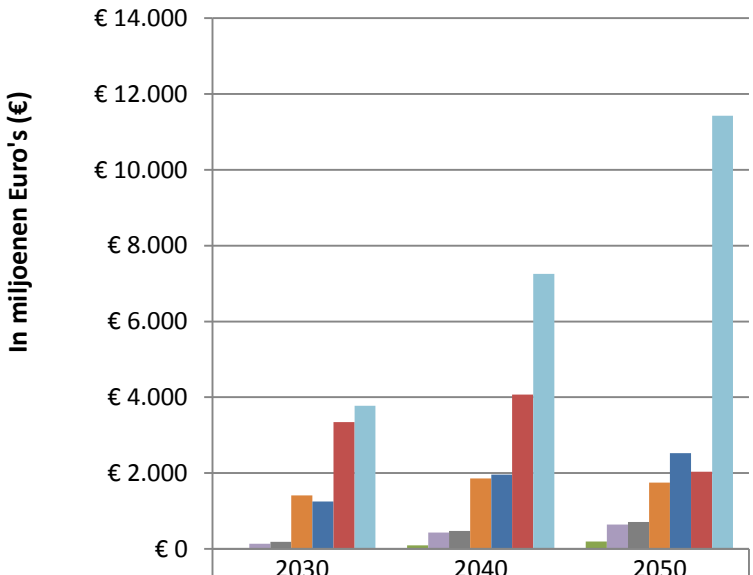
niemand meer begint met roken vanaf 2017 (hoofdstuk 6). In hoofdstuk 7 worden de resultaten van alle scenario's overzichtelijk onder elkaar gezet, inclusief de resultaten van verschillende sensitiviteitsanalyses. Hoofdstuk 8 gaat inhoudelijk in op bevindingen in dit onderzoek en de gebruikte methodes. Ook bevat dit hoofdstuk een concluderende paragraaf waarin ook de implicaties van dit onderzoek worden besproken.

Grafische weergave van resultaten

Figuur 1: Overzicht van de prevalentie van roken per scenario



Figuur 2: Incrementele netto contante waarde per scenario per jaar



	2030	2040	2050
(Jaarlijkse) massa media campagnes	€ 18	€ 93	€ 194
Rookvrije samenleving	€ 132	€ 434	€ 644
Niemand start meer met roken	€ 181	€ 472	€ 710
Maatregelen WHO-verdrag met 5% accijns verhoging	€ 1.410	€ 1.855	€ 1.745
Jaarlijkse accijnsverhoging van 5%	€ 1.247	€ 1.961	€ 2.528
Maatregelen WHO-verdrag met 10% accijns verhoging	€ 3.340	€ 4.069	€ 2.034
Jaarlijkse accijnsverhoging van 10%	€ 3.776	€ 7.253	€ 11.429

Summary

Main outcomes

In the Netherlands approximately 23% of the population of 15 years and older smokes (19.8% of the population from 0-100 years, on which the calculations in this study are based). In the reference or base-case scenario (a scenario in which no changes are assumed in the government's current tobacco control policy for a period of 35 years), the prevalence of smoking will decrease by 2.3 percentage points over the next 35 years. In the alternative scenarios presented in this report, the prevalence could potentially decrease by 14.2 percentage points through tobacco control policies. In addition, all alternative scenarios result in a positive net benefit, though different stakeholders benefit depending on the scenario. In scenarios in which the prevalence decreases, for example as a results of mass media campaigns, the most benefits are gained by consumers (QALY gain) and employers (reduction in productivity losses) and in scenarios in which the excise tax is increased, the most benefits are gained through tax incomes. The scenarios in which a combination of both tax increases and a policy package are introduced (WHO MPOWER) result in benefits for both consumers and employers as government incomes through taxes.

Introduction

In a study in 2012 it was estimated that approximately 3.9 million people in the Netherlands smoke. In addition, smoking is one of the leading causes of cardiovascular diseases, (lung)cancer and chronic obstructive pulmonary disease (COPD). Besides the negative impacts of smoking on health, smoking also causes a significant economic burden to society. In 2010, €2.8 billion was spent on diseases caused by smoking in the Netherlands.

This report describes the societal costs and benefits of smoking, a so-called social cost-benefit analysis (SCBA). In this study, all relevant costs and benefits of smoking are presented in monetary values, while adopting a macro-economic perspective. A SCBA conform the Dutch guidelines for SCBA contributes to informed policy-making and decision-making in the field of public health. This study was commissioned by the Dutch Smoke-free Alliance (ANR) and was funded by the Dutch Cancer Society.

In this report, several smoking-related policy scenarios are being compared;

1) the current situation, which is the reference scenario;
2) an annual 5% excise tax increase;
3) an annual 10% excise tax increase;
4) (annual) mass media campaigns;

5) the introduction of a policy package defined by the WHO (consisting of smoking bans, quit smoking aids, mass media campaigns, advertisements bans - MPOWER), including an annual 5% excise tax increase;
6) the introduction of a policy package defined by the WHO (consisting of smoking bans, quit smoking aids, mass media campaigns, advertisements bans - (MPOWER), including an annual 10% excise tax increase;
7) a scenario in which the Netherlands is smoke-free in 35 years (<5% smoking prevalence);
8) a scenario in which nobody starts smoking from 2017 onwards.

In order to properly map the different interventions, a time horizon of 35 years is chosen. This means that all costs and benefits are calculated until the year 2050. This study provides an overview of the prevalence of smoking in the Dutch society, and costs and benefits expressed in monetary values of each stakeholder (e.g. consumers, employers, and excise incomes).

Method

In a SCBA, the following steps are usually undertaken:

1) Scoping the problem;
2) Determining the reference scenario (determining the costs and benefits in the reference scenario);
3) Defining the distinctive measures;
4) Defining and valuing the costs of concerning measures in the reference scenario;
5) Defining and valuing the benefits of the measures in the reference scenario;
6) Presenting an overview of the costs and benefits of each policy (net value, but also the overview of both debtor and creditor, plus the distributional effects);
7) Sensitivity analyses;
8) Presenting and interpretation of the outcomes.

For the current SCBA, we used the Chronic Disease Model (CDM) developed by the National Institute for Public Health and the Environment (RIVM), the SimSmoke model and a specially designed excel model. The CDM is a Markov model, which is used to estimate disease burden (mortality, morbidity, quality of life), and costs within the health care sector. The impact of each policy scenario - with respect to smoking prevalence and health risk - is calculated through the SimSmoke model. Combining these models, health care costs (including smoking-related health care costs) and quality adjusted life-years (QALYs) are calculated. Next, based on the population numbers from the CDM and

the SimSmoke model, the societal costs (e.g. productivity losses) are calculated through the specially designed excel model. A discount rate of 3% is used in this study. For the reference scenario, both discounted and undiscounted results are presented. The costs and benefits are presented in the following categories: the monetary value of QALY health gains (valued at €50,000 per QALY); smoking-related health care costs; other health care costs; smoking-related Alzheimer costs; smoking related eye disease costs; value of consumer surplus; government incomes through taxes; costs of fire damage; costs to the environment; absenteeism/presenteeism (direct productivity losses); productivity transfer costs; (old-age) pension transfer costs; absenteeism/presenteeism (indirect productivity losses); and intervention costs. The producer surplus and the impact of the reviewed policies on the labour market are not included in the model.

The consumer surplus is included in the model (conform guidelines) although this is a difficult concept to interpret when consumption is driven by addiction, as the smoking is (partly) involuntary. The producer surplus and the impact of the policies on the labour market are not included in the model (conform guidelines) as no policy directly intervenes within the market and changes in these sectors are expected to lead to distributional effects only on the long term.

To examine the validity of the assumptions and results in the study, several sensitivity analyses have been performed. We performed one-way sensitivity analyses by examining the impact of different valuations of the QALY (i.e. €20,000 - €100,000 - €200,000) and three different effectiveness estimates for mass media campaigns (low, normal, high impact). In addition, probabilistic sensitivity analyses were performed to examine the uncertainty around main parameters within the CDM (such as population numbers, start/stop probabilities of smoking, and health care costs).

Results

Scenario 1: The reference scenario

In this scenario no changes are assumed in the government's current smoking-related policy for a period of 35 years. It appears that the prevalence of smoking decreases with 2.3 percentage points, from 19.8% in the year 2015 to 17.5% in the year 2050. Furthermore, smoking-related health care costs will increase from €8.3 billion in 2015 to €10.9 billion in 2050 (no discounting applied). Also, the value of the consumer surplus will decrease and the value of QALYs will increase in this period.

Scenarios 2 & 3: Annual tax increase of 5% and 10%

In these scenarios the effects from an annual 5% and 10% tax increase are calculated for society. The price increase is multiplied with the total price elasticity of demand of smoking (-0.4) in each scenario. It is worth noting that only half of this elasticity is attributed to a decrease in smoking prevalence (prevalence-elasticity of -0.2), because there are people who will smoke less but do not

quit entirely. The other half (intensity-elasticity of -0.2) is attributed to a decrease in the sale of cigarettes. It is important to note that the effect of prevalence elasticity is not linear. Over time, the prevalence elasticity will decrease, however due to the complexity of the model and the annual changes in the transition rates, the absolute decrease in smoking prevalence is difficult to point out. Government income through taxes increases in both scenarios. Increasing the annual taxes by 5% leads to government income of €4.3 billion per year in 2050, and increasing annual taxes by 10% leads to government income of €23.5 billion per year in 2050 – which compares favourably to the €1.2 billion anticipated in the reference scenario. The cumulative net benefit (all the benefits minus all the costs over the whole time horizon) in these scenarios is €57 billion and €179.4 billion respectively.

Scenario 4: Mass media campaign

In this scenario, we estimated the effects of an annual mass media campaign. A mass media campaign is the provision of information through television, radio, billboards etc. to discourage smoking. International literature shows that the effectiveness of such a campaign may lead to a decrease of smoking prevalence by 0.4 - 7.0 percentage points annually; we assume a relative decrease of smoking prevalence of 1.2% each year. Based on the 2008 campaigns, it is calculated that the campaign costs will be €6.15 million in the first year and €4.62 million for each subsequent year. It is further assumed that the campaign will be renewed every three years to avoid campaign weariness, costing €6.15 million every first year of the renewal. In this scenario, the prevalence of smoking decreases to 12.5% in 2050. Furthermore, we expect to see decreases in government income through taxes, substantial QALY health gains, and substantial increases in productivity. The cumulative net benefit in this scenario is €2.2 billion.

Scenarios 5 & 6: WHO policy package with 5% and 10% annual tax increase

In these scenarios, the consequences of policy measures from the WHO FCTC treaty, the MPOWER package, are estimated – with annual tax increases of 5% and 10%. The MPOWER package consists of smoking bans, help with quitting smoking, mass media campaigns, advertisements bans and tax increases. These scenarios are a combination of provision of information/education on the one hand, and annual tax increases on the other hand. The smoking prevalence decreases in these scenarios to 7.7% and 5.6% in 2050. Also, a significant increase of government incomes through taxes and increases in productivity is apparent, as well as a strong increase in QALY health gains. The cumulative net benefit in these scenarios is €52.9 billion and €98.9 billion respectively.

Scenario 7: Smoke-free society (prevalence <5%)

In this scenario, the costs and benefits were counted back from the desired result: a smoking prevalence of <5% in 2050. No further adjustments have been made to the model compared to the reference scenario. In this scenario, the value of QALYs increase significantly and government income through taxes decreases. Also, major improvements in work productivity are noticeable. The cumulative net benefit in this scenario is €9.1 billion.

Scenario 8: Nobody starts to smoke

In this scenario, the probability that a person initiates smoking is assumed to be zero from 2017 onwards. This leads to a significant increase in QALY health gains and a decrease in government income through taxes. Also, major improvements in work productivity are noticeable in this scenario. Moreover, the prevalence decreases to 4.8% in 2050 and the cumulative net benefit in this scenario is €10.3 billion.

Conclusion

This SCBA shows that, when no new policy measures are implemented, the prevalence of smoking will decrease by 2.3 percentage points over the next 35 years. The policies reviewed in this report have the potential to decrease smoking prevalence by 14.2 percentage points (and in a 'smoking-free society scenario, by as much as 17.4 percentage points). Furthermore, the results show that the intervention costs for all scenarios are minimal, and that investing in health is beneficial as seen from both the public health and fiscal perspective. It is important to note the relationship between the chosen policy measures and the estimated impacts.

For instance, annual tax increases lead to an increase in government incomes but also result in a relatively weak effect on smoking prevalence and disease burden. In contrast, mass media campaigns also have a positive effect on smoking prevalence but a negative effect on government incomes. The WHO policy packages with 5% and 10% excise tax increases lead to a positive effect on both smoking prevalence and government income. The consumer surplus decreases in all scenarios. If the consumer surplus is not taken into account, the results of the policy scenarios show even greater positive effects.

It is necessary to keep in mind that annual tax increases may lead to crowding-out effects / frontier effects. European legislation could potentially negate these effects. Nevertheless, this SCBA shows that all scenarios presented result in both short-term and long-term positive net benefits. Hence, this study highlights important future insights to smoking cessation within the Netherlands.

Instructions for readers

This report is divided in several chapters. Chapter 1 provides an introduction and aims of the study. Chapter 2 discusses the steps usually taken to conduct an SCBA and will provide more insights into the different models that are used in order to obtain results. Next the reference scenario will be discussed (Chapter 3), afterwards the different alternative scenarios will be discussed: the scenarios which focus on an annual 5% and 10% excise tax increase (Chapter 4.1); (annual) mass media campaigns (Chapter 4.2); the introduction of a policy package defined by the WHO including an annual 5% or 10% excise tax increase (Chapter 5); a scenario in which the Netherlands is smoke-free in 35 years (<5% smoking prevalence; Chapter 6.1); and a scenario in which nobody starts smoking from 2017 onwards (Chapter 6.2). In Chapter 7 an overview is presented of the results of all the scenarios side-by-side, including the sensitivity analyses. Lastly, Chapter 8 discusses the implications of the results and discusses important methodological considerations.

Graphical representation of results

Figure 1: Overview of the smoking prevalence per scenario

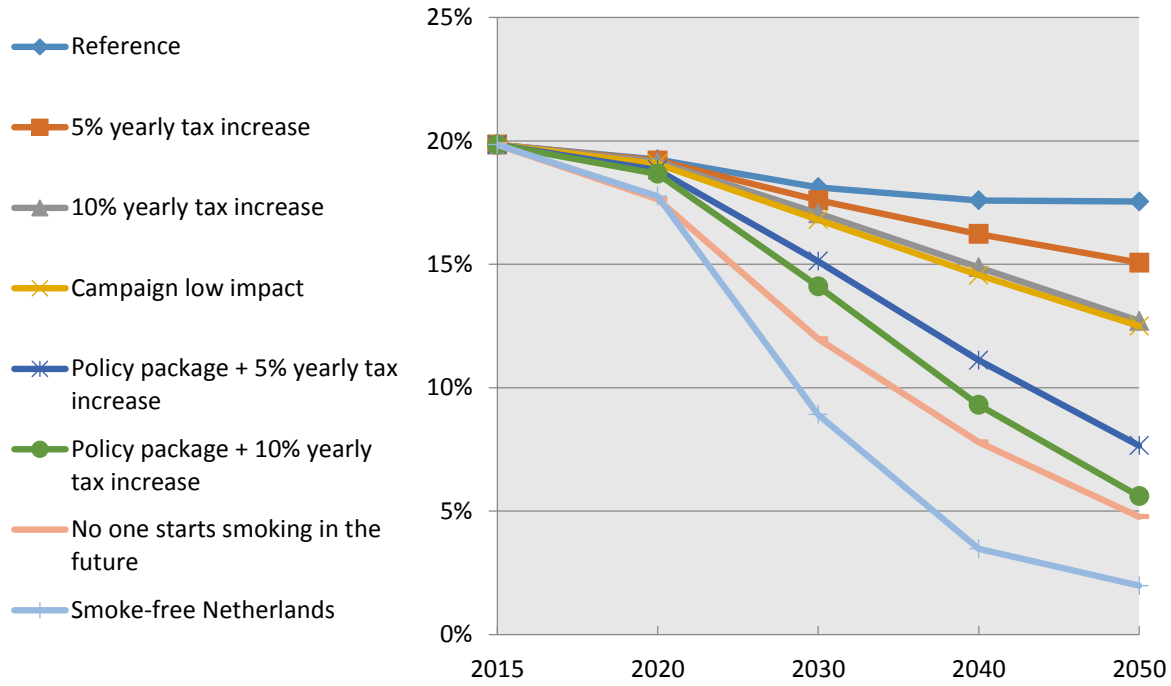
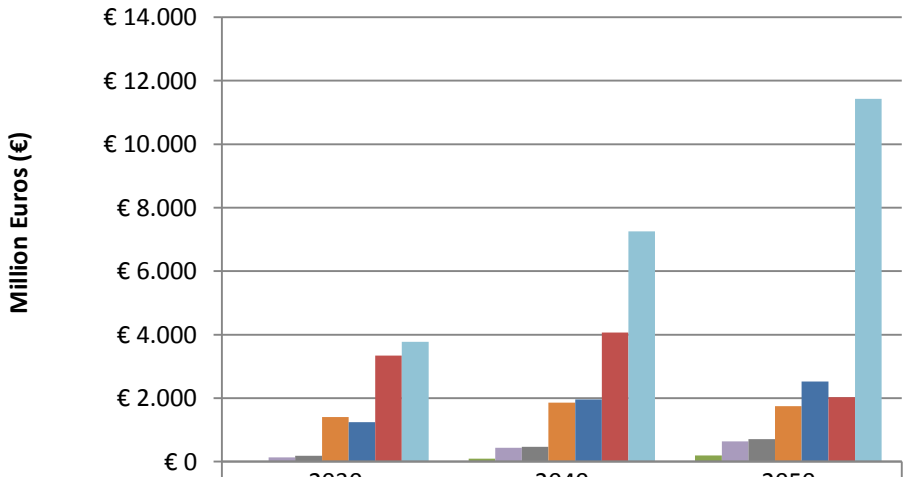


Figure 2: Incremental net benefit per scenario per year



	2030	2040	2050
Mass media campaigns	€ 18	€ 93	€ 194
Smoke-free Netherlands	€ 132	€ 434	€ 644
No one starts smoking in the future	€ 181	€ 472	€ 710
Policy package + 5% yearly tax increase	€ 1.410	€ 1.855	€ 1.745
5% yearly tax increase	€ 1.247	€ 1.961	€ 2.528
Policy package + 10% yearly tax increase	€ 3.340	€ 4.069	€ 2.034
10% yearly tax increase	€ 3.776	€ 7.253	€ 11.429

1. Introduction: Scoping the problem

According to the World Health Organization (WHO), 13.5% of the world's population smokes [1]. An estimated 6 million persons worldwide die due to tobacco each year [1]. Over 83% of those deaths are the result of direct tobacco use and approximately 10% die because of exposure to second-hand smoke as a non-smoker [1]. If current trends continue, it is expected that the number of annual deaths due to smoking will increase by 33% in 2030.

In the Netherlands, over 3.9 million people of 15 years and older smoke, which is equivalent to a smoking prevalence of 23% of 2012. More than 13% of the total disease burden in the Netherlands is caused by tobacco smoking, making smoking the most important preventable risk factor [2]. This is mainly due to the fact that smoking is associated with cardiovascular disease, cancer of the lungs, and chronic obstructive pulmonary disease (COPD) among other diseases. More specifically, smoking causes 91% of the lung cancers and 85% of the COPD incidence [2].

In 2013, an estimated 19,000 persons (0,5% of the smoking population) died because of smoke-related diseases in the Netherlands [2]. A 2014 study on the effect of smoking on the duration of life in Belgium found that people who smoke live 8 years shorter than non-smokers [3].

Smoking does not only affect its users, but also affects people who inhale tobacco smoke as second-hand smokers (passive smokers). For passive smokers, the risk of developing lung cancer and heart diseases increase by 20-30% compared to people who are not exposed to tobacco smoke [4]. Although no recent data are available, it is estimated that in the Netherlands thousands of people die each year due to the adverse health consequences of passive-smoking [4, 5].

In addition to the disease burden, smoking imposes a substantial economic burden. In 2010, €2.8 billion were spent on diseases caused by smoking in the Netherlands, which represents 3.8% of the total health care budget [6]. In addition to the significant direct health care costs due to smoking, smoking is also responsible for substantial indirect costs such as premature deaths and productivity losses [2]. Furthermore, the external costs associated with the consumption of tobacco, in other words, costs that are borne by people other than the smoker himself, are substantial, such as the health damage and annoyance caused by passive smoking [4].

The Dutch Alliance for a smoke-free society (Alliantie Nederland Rookvrij – ANR), an initiative by the Dutch Lung Foundation, the Dutch Heart Foundation and the Dutch Cancer Society, has developed a

tobacco control policy scenario that gradually leads to a smoke-free generation [7]. This policy scenario aims to bring smoking prevalence among youth close to zero by 2035 via measures such as mass media campaigns, smoke-free areas, various regulations to protect youth from being exposed to tobacco marketing, and annual excise increases, focusing on creating conditions in which every parent with a child can raise his or her child in a smoke-free environment, and be confident that his or her child will not start to smoke.

These measures may result in very low future smoking prevalence rates amongst adults as well.
In 2005, the WHO Framework Convention on Tobacco Control (FCTC) presented a package of tobacco control measures to be adopted nationally by over 40 countries, including the Netherlands. These FCTC measures were presented in a so-called MPOWER package: **M**onitor tobacco use and prevention policies, **P**rotect people from tobacco smoke, **O**ffer help to quit tobacco use, **W**arn about the dangers of tobacco, **E**nforce bans on tobacco advertising, promotion and sponsorship and **R**aise taxes on tobacco. As stated in a report from 2014 by the ANR, by signing the FCTC Convention, the Dutch government has committed itself to implementing the tobacco control measures included in the Convention in order to continually and substantially reduce smoking prevalence and exposure to tobacco smoke [8]. However, the report concluded that there still is a long way to go before full implementation of the FCTC is realized [8]. In order to realize a smoke-free generation and bring down smoking prevalence rates in the population, more measures are needed. In the Netherlands, economic considerations are important when policymakers decide on new policy measures to reduce smoking. The question whether tobacco use is beneficial or detrimental from a macro-economic perspective, cannot be answered easily. Several attempts to assess the monetary costs and benefits for the Dutch society have been made in the past, with varying results [9-12]. Some were used as a justification to intensify tobacco control policy. Recently, the Dutch Institute for Economic Research (SEO) published a report on the costs of smoking in the Dutch society [13]. This report concluded, amongst other things, that currently a Dutch society with smoking is causing less health care costs than a world without smoking, but this is likely to change in the future due to new medical technologies. The insights and data provided by the SEO report are very helpful for current and future research into to societal costs and benefits of tobacco use.

An important drawback of previous studies [9-12] was the lack of a standard methodology of how exactly a social cost-benefit analysis should be conducted.

In 2013, national guidelines were developed for the proper and standardized execution of social cost-benefit analyses of future policies in public health [14]. Next, in the Public Health Status and

Forecasts Report (VTV) 2014 [15], a reflection on the role of social cost-benefit analysis within health care was made, including some methodological remarks [16]. Hence, building on this increased awareness, in 2014, the National Institute for Public Health and the Environment (RIVM) published a report on societal cost-benefit analyses (SCBA) for prevention and care [16]. This report provides a general guideline on how to perform a SCBA for health care related policies.

Inspired by the VTV 2014 report and funded by the Dutch Cancer Society (KWF), the ANR commissioned a consortium of experts from three academic centres – Maastricht University; Trimbos Institute (Netherlands Institute of Mental Health and Addition) and the RIVM– to conduct a SCBA using the latest insights on how to conduct such an analysis as guiding principles. The main research questions were “What are the economic costs and benefits associated with a smoke-free society?”, “What social costs- and benefits can be expected when the Netherlands is completely smoke-free by 2030, 2040, or 2050?”, and “How do costs and benefits change over time?”. In addition, the Alliance wanted to know which sectors in society could expect to incur costs and in which sectors accrue profits (e.g. who pays and who benefits?).

This study sets out to address these research questions in a systematic and comprehensive manner and will follow the latest guidelines for conducting social cost benefit analysis.

2. Social cost benefit analysis (SCBA)

This chapter describes the methodology of the current SCBA, which use an eight-step approach. The essential theoretical foundations of Cost-Benefit Analysis are benefits defined as increases in human wellbeing (utility) and costs defined as reductions in human wellbeing. An intervention or a policy measure is acceptable from a social cost-benefit perspective when the sum of social benefits exceeds the sum of social costs. We use the term 'social' instead of societal because "Societal" is simply the sum of individuals [17].

To increase robustness and validity of the assumptions, results, and conclusions in this report, the authors were assisted by a project team (see appendix A for more details), an expert group (see appendix B for more details), and a consultation group (see appendix C for more details).

2.1 Steps of a SCBA

We follow the methodology of a social cost benefit analysis (SCBA) as outlined in the most recent literature in the field of public health. In response to the many challenges within this field, a Dutch SCBA addition for public health was developed to assure the quality and methodological consistency [16]. It is an extension of the general Dutch SCBA guidelines [14]. Furthermore, to give more practical guidance, SCBA instructions for the social domain, which is a practical extension of the SCBA guidelines, were recently published [18]. Both guidelines were used for this study.

An analysis of incremental costs and benefits is referred to as SCBA when the cross-sectorial impact of a policy to society is considered. Implementation of a new policy would result in additional costs and benefits in several domains of society such as health care, employability, consumption and so on. Therefore, a SCBA has to map the distribution of the short-term and longer-term costs and benefits of implementing the new strategies over all the stakeholders that might be affected. A SCBA evaluates the favourable and adverse effects of policy actions and the associated opportunity costs of those actions. The favourable effects are defined as the benefits, and the opportunities foregone are defined as the economic costs. The SCBA provides an overview of all effects, risks and uncertainties of a policy, and the resulting advantages and disadvantages for society as a whole. By quantifying and monetary valuing these advantages and disadvantages as much as possible in Euros, the SCBA provides insight into the impact of the measure on social welfare, expressed as the balance of benefits (in Euros) minus the costs. To avoid the problems that arise when arbitrary decisions are made as to whether a certain item is a cost, a saving, or a benefit, the overall results are reported as a net benefit. This balance between costs and benefits also includes aspects of the social welfare for which no market prices exist (e.g. tobacco odour annoyance). If the monetized balance of the total

costs and total benefits is positive, then this will lend support to the new prevention interventions. The valuation of the costs and benefits in a SCBA allows comparing and ranking the various policy options. A SCBA is conducted in several steps. In general, eight research steps shown in Figure 2.1 can be distinguished [14]. Below Figure 2.1, each of these steps is described in more detail.

Figure 2.1 Research steps of a social cost benefit analysis (adapted from [16])

Step 1: Scoping the problem

This step describes the state of affairs under the current regulatory policies for tobacco control in the Dutch society and helps to ensure that the SCBA is well directed at the present policy issue. When scoping the problem, the focus lies on the current situation including both epidemiological and economic consequences that will arise or perpetuate when current policies remain unaffected the coming 35 years. Scoping the problem is important in order to make sure that the policy problem provides a sufficient basis for a meaningful SCBA. Furthermore, the SCBA contributor must check whether the design of the SCBA is suitable for the problem and whether no other relevant solutions have been overlooked.

Step 2: The reference scenario

The reference scenario is the status quo scenario without additional tobacco control policies and describes expected (autonomous) trends into the future under the current set of policies, planned policies and other (small) interventions that will (partly) influence the trends into the future. The reference scenario is crucial for comparing the impacts of the alternative policies (see Step 3). The consequences of tobacco use in society are described as smoking-related illnesses (e.g. stroke, cancers, COPD, etc.) and the number of people suffering from passive smoking. Multiple sources of information are used to estimate these volumes: scientific and grey literature, data from Statistics Netherlands and other national databases. Quantification depends on the availability of data.
The estimates are based as much as possible on robust evidence, thus preferring meta-analyses over single primary studies and preferring empirical data over expert opinion. Nonetheless, data quality varies.

Step 3: Alternative policy scenarios

The alternative scenarios include the regulatory policies that were suggested by ANR. The combination of alternative policy scenarios and the reference scenario were chosen in such a way that the analyses address ANR's research questions. The current SCBA will assess multiple policy scenarios, and more information about the content of these scenarios can be found in the related chapters. In this step, assessments will be made to what extent each policy measure affects the consumption of tobacco in the Dutch population. The direct and indirect effects of these policies on the identified actors and sectors will be investigated and quantified.

Step 4: Define and value benefits

Euro values are assigned to the benefits for the various stakeholders relative to the reference scenario. To illustrate, health gains will be valued in monetary terms, for which we will rely on the available SCBA instructions [18]. Assigning a monetary value to each of the effects helps to make comparisons across policies and to decide on whether or not to implement new policies.

Step 5: Define and value costs

The costs of implementing and maintaining a new policy and the economic effects of that policy on the different actors and sectors will be assessed relative to the reference scenario, and Euro values will be assigned to these effects. When necessary, a distinction is made between initial investments and on-going operating costs, as well as between fixed and variable costs.

Step 6: Assess the net present value of the incremental costs and benefits

Where possible, a table is made listing all actors/sectors with the costs they incur, the benefits they receive as to obtain a complete overview of the distribution of costs and benefits across

actors/sectors. Such costs and benefits will be reviewed over the appropriate time period and summarized for the years 2015 (reference year), 2017 (start policies), 2020, 2030, 2040 and 2050. The time horizon of this SCBA is therefore 35 years. The net present value is assessed using all costs and benefits for the reference year 2015 and by discounting the costs and benefits occurring at later points in time.

The balance of the sum of all costs and all benefits is used to evaluate the pay out of the new policies, which can either be positive (i.e. total benefits exceeding total costs) or negative (i.e. total costs exceeding total benefits). Some costs and benefits cannot be meaningfully measured or estimated or converted into monetary terms. Such costs and benefits will be referred to as a pro memory post (PM).

Step 7: Sensitivity analyses

The main analysis conducted in Step 6 will be subject to sensitivity analyses to assess the robustness of the study outcomes, in particular the uncertainty surrounding the input parameters and the assumptions that had to be made such as effectiveness of the mass media campaigns. In addition, sensitivity to different discount rates will be described. More details of the sensitivity analyses can be found in the related paragraphs.

Step 8: Present outcomes

We reported the outcomes of both the main analysis and the sensitivity analyses in agreement with the pertinent guideline for reporting economic evaluations in a transparent and replicable way [19]. This was done for each of the policy options and includes a list of the non-monetized costs and benefits.

2.2 Structure of this report

This report follows the eight SCBA research steps as described above. Step 1 – scoping the problem – is described in the introductory chapter. The second step – determine the reference scenario - is introduced in Chapter 3. Step 3 – alternative policy scenarios – are described in three parts within the report: in Part I single policy alternatives are evaluated; in Part II a regulatory policy package is investigated; in Part III the effects of a smoke-free Netherlands is estimated; finally, in part IV a side-by-side overview is presented of all scenarios (See Table 2.1).

Table 2.1 Overview of the evaluated scenarios

Reference scenario	(see Chapter 3)
Part I Single policy alternatives	
Annual 5% tax increase	(see Chapter 4.1)
Annual 10% tax increase	(see Chapter 4.1)
Campaign low impact	(see Chapter 4.2)
Part II Policy packages	
Policy package with annual 5% tax increase	(see Chapter 5)
Policy package with annual 10% tax increase	(see Chapter 5)
Part III Smoke-free Netherlands	
Smoke-free Netherlands (<5% smoking prevalence)	(see Chapter 6.1)
No one starts smoking from 2017 onwards	(see Chapter 6.2)
Part IV Overview of net present value per scenario	
Smoking prevalence per scenario	(see Chapter 7.1)
Social effects per scenario	(see Chapter 7.2)
Financial effects per scenario	(see Chapter 7.3)
Total costs per scenario	(see Chapter 7.4)
Sensitivity analyses	(see Chapter 7.5)

For all the different policy scenarios described within this report, the SCBA Steps 4 – 7 (define and value benefits, define and value costs, assess net present value, and conduct sensitivity analyses) are repeated and described per policy scenario. The methodology used for quantifying and valuing effects are explained in the related paragraphs.

The overall outcomes of the SCBA (step 8) per scenario are described and discussed in chapter 7.

2.3 Modelling

The effects of the different scenarios on smoking prevalence and on future costs and benefits are estimated by predictive modelling. For this SCBA, a predictive model was needed that incorporates the demographics of the Dutch population (birth, death and migration rates), smoking prevalence, health care usage and inter-sectoral costs and benefits attributable to smoking and could in addition model changes in healthy life years (QALYs) gained or lost. Furthermore, we required that the model was able to predict smoking behaviour and related consequences in the Dutch population when tobacco control policies (single policies and policy packages) are implemented. After reviewing several models (e.g. Mendez model [20], EQUIPT model [21], and the NICE ROI tool [22]; see appendix D) it became clear that in order to meet our selection criteria, the use of two existing models, the RIVM-Chronic Diseases Model (CDM) [23], SimSmoke [24] and a newly developed Social Cost Benefit (SCB) Excel model was needed. Further details of the models are given below. The models are used in combination within this report as they are complementary to each other. See Table 2.1 for the model features.

Table 2.2 Model features of the CDM, SimSmoke and SCB model

	CDM	**SimSmoke**	**SCB model**
Model features	Predictive model Dutch population figures Dutch smoking prevalence Single policies Chronic diseases Health care costs QALYs	Predictive model Dutch population figures Dutch smoking prevalence Impact of policy packages on smoking prevalence	Predictive model Inter-sectoral costs Inter-sectoral benefits
Used for:	Trends in smoking behaviour over time, QALY gains, and health care costs related to smoking-related chronic diseases.	To model the effect of a full set of multiple interventions on smoking prevalence. Estimates were replicated in calculations of CDM	To estimate other social costs and benefits such as consumer surplus, productivity, government, producer surplus, labour participation, insurances and others in society.

RIVM-Chronic Diseases Model (CDM)

The CDM is a dynamic population-based model specifically developed to evaluate the effects of public health policies on the incidence and prevalence of chronic diseases in the Dutch population. The CDM is formulated mathematically as a set of time-continuous differential equations [23]. The model's equations describe the 1-year changes of the probability to make a transition across disease states conditional on risk factor classes, in gender and age specific cohorts. The model's output consists of the numbers of incident and prevalent cases of smoking-related diseases and numbers of death by age and gender. In total, the model incorporates the mortality and morbidity associated

with the incidence of 13 smoking-related chronic diseases. The CDM has been used for future projections of risk factor and disease prevalence numbers [25-27], cost-effectiveness analyses [28] and estimates of healthy life expectancy [29].

The CDM is used in our SCBA to model the development of age- and gender-specific smoking behaviour over time and will generate quality-adjusted life years (QALY) and health care costs associated with smoking-related chronic diseases. QALYs are computed based on utilities (1 – disability) weights for the diseases included in the CDM [23, 28-30]. Additionally, the model estimates the total health care costs of the entire population and therefore, it will take into account the additional health care costs of the population in life years gained. The output of the CDM will be used to directly estimate the impact of tobacco policies in the health care domain (see figure 2.2).

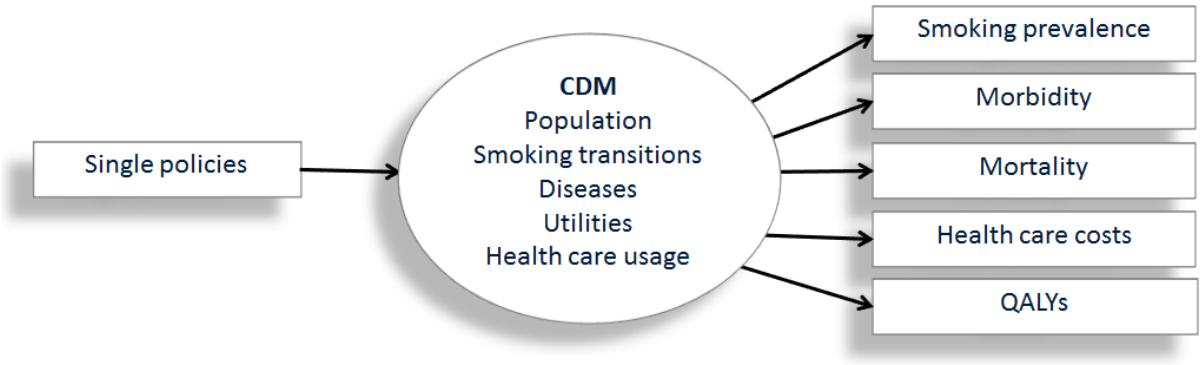


Figure 2.2 Graphical presentation of the CDM

Demographic data such as all-cause mortality rates and initial population numbers within the CDM are derived from Statistics Netherlands [31]. Incidence, prevalence and mortality rates are based on general practitioner registrations for non-cancer diseases, national cancer registries and cohort studies for diabetes [30, 32, 33]. When estimating mortality, the model takes account of competing death risks, combining the results from the various disease-specific modules with the demographic module. To compute health effects in terms of QALYs, disease prevalence rates are coupled with disability weights from the Dutch Burden of Disease Study [29]. Health care costs are calculated by coupling disease prevalence with costs per patient per year per disease, of which the data is available from the Dutch Costs of Illness study [28, 34].

Smoking behaviour is included in the CDM in the categories: 'current smoker', 'ex-smoker', and 'never smoker'. A smoker is defined as a person who smokes, irrespective of the frequency of smoking, the amount (s)he smokes and what type of tobacco they smoke. A persons who is once defined as a smoker can never become a 'never smoker'. Someone can become a smoker from the

age of 10 years old. The CDM has a time dependence part for the time since someone quit smoking, with the final category comprising of persons who quit smoking 20 years (or longer) ago.
The CDM is able to relate changes in smoking prevalence to changes associated with the incidence of 13 smoking-related chronic diseases (see Table 2.3). The incidence rates of smoking-related diseases are increased in current smokers as well as in former smokers, with the relative risk of former smokers declining from the risk of a smoker immediately after stopping smoking to that of a never smoker as a function of time since cessation.

Table 2.3 Smoking-related chronic diseases included in the CDM

Cancers:	Cardiovascular diseases:	Other:
Lung	Myocardial infarction	Chronic obstructive pulmonary diseases (COPD)
Stomach	Congestive heart failure	Diabetes
Larynx	Stroke	
Oral cavity		
Oesophagus		
Pancreas		
Bladder		
Kidney		

SimSmoke

In the Netherlands, the CDM has been used to examine the impact of tobacco control policies on smoking rates and health risks [25, 29, 35-37] The SimSmoke model, which is internationally well accepted [33, 38-48] and has previously been adapted for use in the Netherlands [24] will be used in conjunction with the CDM to model the effect on smoking prevalence of the full set of multiple interventions.

Most modelling studies of tobacco control policies have examined the effect of only one or two policies because the ability to disentangle the effects of tobacco control policies on smoking rates is often limited by lack of data or models that can statistically distinguish the effects. Simulation models examining the effect of multiple tobacco control policies have been developed by Mendez and Warner [49, 50], Tengs et al. [51-53], Ahmad [54-56] and Levy et al. [57, 58]. Levy et al.'s model is referred to as the SimSmoke model and assesses separately, and in combination, the effect of seven types of policies: taxes, clean air, mass media, advertising bans, warning labels, cessation treatment, and youth access policies. The model has proven to be a good prediction model for smoking prevalence in the Netherlands [24].

Figure 2.3 Graphical presentation of SimSmoke

The Netherlands SimSmoke model, similar to the Chronic Disease Model, includes a population module, a smoking module, a smoking-attributable death module and policy modules [57-59] and divides the population in 'current smokers', 'never smokers' and 'former smokers' by age and gender. Different from the CDM, SimSmoke calibrates its outcomes on input data on previously implemented policies in the Netherlands and historical trends of the Dutch smoking population. SimSmoke is a Markov-type discrete time, dynamic population-based model, in which population growth evolves through births and deaths, and smoking rates evolve through smoking initiation, cessation and relapse rates. Mortality counts in total and by cause of death, specified for lung cancer, heart diseases and COPD are derived from Statistics Netherlands [31]. Data on current and former smokers were derived from the Continuous Survey of Smoking Habits in the Netherlands, which is a cross sectional population survey of respondents (≥15 years) that is used to monitor smoking habits of the Dutch population by using weekly measurements. More details of the Netherlands SimSmoke model can be found elsewhere [24].
We calibrated the CDM to mimic the smoking prevalence over time in SimSmoke for the scenarios that simulate the full set of multiple interventions, see appendix E for details.

SCBA model

The CDM and SimSmoke will analyse the impact of one (or more) tobacco control policies on age- and gender specific smoking behaviour over time in the Netherlands. Aside from this, health care costs of included smoking-related chronic diseases and QALYs will be output data from the CDM. To estimate other social costs and benefits, Microsoft Excel will be used to synthesize all output data from CDM. The SCBA model includes costs and benefits for the following domains: health care, consumers surplus, quality of life, productivity, government, producer surplus, labour market, insurances and others in society. More information on the separate domains can be found in the corresponding paragraphs of the SCBA report. Costs and benefits occurring after one year will be discounted at 3%, according to the Dutch guidelines [14, 60].

The CDM is used to model the development of (age- and gender-specific) smoking behaviour over time, which will then be used to estimate the costs and benefits in the different domains (see Figure 2.4). QALYs are estimated based on (age- and gender-specific) smoking behaviour over time and are used to (partly) estimate productivity losses (see paragraph 3.4 for more information on this topic).

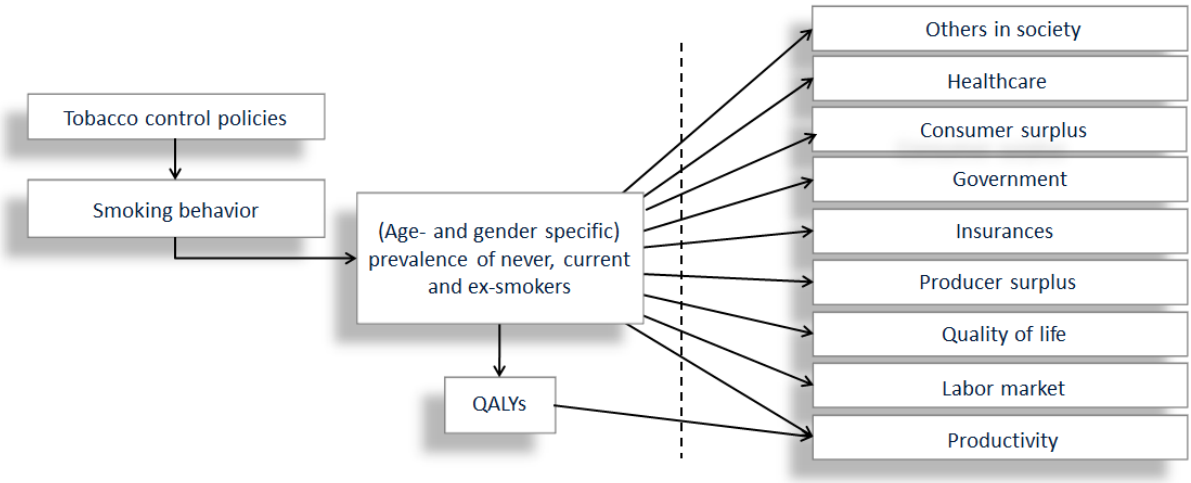


Figure 2.4 Conceptual SCBA model of the input versus output

3. Reference scenario: Costs and Benefits

The smoking prevalence in the reference scenario is estimated with the CDM. The division of the Dutch population into CDM risk classes (smoker, ex-smoker and never smoker) are based on data from the Continuous Survey of Smoking Habits in the Netherlands from 2011 'Continu Onderzoek Rookgewoonten (COR)' [61]. Within the CDM, transitions between risk classes are modelled based on data from the COR [61]. Transitions are possible from never-smoker to smoker (start), from smoker to ex-smoker (quit) and from ex-smoker to smoker (relapse).

An overview of the structure of Chapter 3 can be found in Figure 3.1.

Figure 3.1 Overview Chapter 3

3.1	Smoking prevalence
3.2	Health care impact
3.3	Consumer surplus
3.4	Quality Adjusted Life Year (QALY)
3.5	Productivity
3.6	Government
3.7	Producer surplus
3.8	Labour Market
3.9	Others in society
3.10	Overview cost and benefits
3.11	The impact of discounting
3.12	Sensitivity analyses

3.1 Smoking prevalence

Based on the COR study among the Dutch population of 15 years and older, the smoking prevalence in the Netherlands was 23% within this fraction of the population in 2014. The smoking prevalence estimates of this report are based on the entire population between 0 and 100 years. Therefore, the smoking prevalence in the reference scenario as estimated by the CDM is somewhat lower: 19.8% in 2015. Furthermore, the CDM estimates that if tobacco control policies remain unchanged from their 2015 levels, as in the reference scenario, adult smoking is projected to decrease from 19.8% in 2015 to 19.6% by 2017, to 19.3% by 2020, to 18.1% by 2030, to 17.6% by 2040 and to 17.5% by 2050 (See Table 3.1). Therefore, without any change in tobacco control policies, there is a decreasing autonomous trend in smoking prevalence.

Table 3.1 Reference scenario: Gender specific smoking prevalence projections

	2015	2017	2020	2030	2040	2050
Male smokers	21.9%	21.6%	21.2%	19.9%	19.4%	19.3%
Female smokers	17.8%	17.6%	17.3%	16.3%	15.8%	15.7%
All smokers	19.8%	19.6%	19.3%	18.1%	17.6%	17.5%
Male ex-smokers	28.9%	28.7%	28.4%	26.7%	24.6%	22.9%
Female ex-smokers	29.0%	28.9%	28.6%	27.1%	24.7%	22.1%
All ex-smokers	28.9%	28.8%	28.5%	26.9%	24.6%	22.5%
Male never smokers	49.2%	49.7%	50.4%	53.3%	56.0%	57.8%
Female never smokers	53.2%	53.5%	54.1%	56.6%	59.5%	62.2%
All never smokers	51.2%	51.6%	52.3%	54.9%	57.8%	60.0%

3.2 Health care impact

Table 3.2 presents the prevalence of smoking related chronic diseases in the Dutch population over time. The numbers present the total prevalence of lung cancer etc. in the entire population, including the portion caused by smoking.

Table 3.2 Reference scenario: Prevalence* of smoking-related diseases

Chronic diseases	2015	2017	2020	2030	2040	2050
Lung cancer	0.22%	0.22%	0.23%	0.25%	0.24%	0.22%
Stomach cancer	0.04%	0.04%	0.04%	0.04%	0.05%	0.05%
OOesophagus cancer	0.05%	0.05%	0.05%	0.06%	0.06%	0.05%
Larynx cancer	0.05%	0.05%	0.05%	0.05%	0.05%	0.04%
Bladder cancer	0.12%	0.12%	0.13%	0.15%	0.16%	0.16%
Kidney cancer	0.12%	0.12%	0.12%	0.13%	0.14%	0.13%
Pancreas cancer	0.02%	0.02%	0.02%	0.03%	0.03%	0.03%
Oral cavity cancer	0.03%	0.03%	0.03%	0.03%	0.02%	0.02%
Myocardial infarction	4.01%	4.10%	4.23%	4.56%	4.64%	4.52%
Congestive heart failure	0.92%	0.96%	1.02%	1.24%	1.38%	1.42%
Stroke	1.37%	1.44%	1.54%	1.80%	1.90%	1.89%
COPD	2.55%	2.66%	2.83%	3.16%	3.12%	2.96%
Diabetes	5.50%	5.66%	5.87%	6.39%	6.56%	6.53%

* The prevalence refers to the total prevalence, attributable and non-attributable to smoking

The projected chronic diseases are not only caused by smoking; lack of exercise, unhealthy nutrition, obesity, alcohol (ab)use and ageing are other risk factors. In order to estimate the proportion of smoking related diseases in the population caused by smoking, the prevalence of the smoking related chronic disease is simulated in a scenario in which smoking does not exist. In Table 3.2, the proportion of smoking-related chronic diseases in future years caused by smoking is presented[2]. Some diseases will become more prevalent when smoking would not exist, see for example the negative proportions for congestive heart failure and diabetes in 2050. This can be explained by the fact that without smoking, people will live longer, which is in itself a risk factor for heart failure and diabetes.

[2] Estimated by comparing the reference scenario with a scenario in which smoking does not exist.

Table 3.3 Percentage of the prevalence of smoking-related diseases which is attributable to smoking

Chronic diseases	2015	2017	2020	2030	2040	2050
Lung cancer	61.7%	65.0%	67.2%	68.3%	67.5%	67.9%
Stomach cancer	4.6%	4.8%	4.6%	1.4%	0.0%	0.0%
Oesophagus cancer	37.3%	39.1%	40.0%	38.3%	35.5%	34.9%
Larynx cancer	26.0%	31.4%	38.2%	51.1%	56.6%	61.1%
Bladder cancer	14.3%	16.3%	18.2%	18.1%	14.7%	12.5%
Kidney cancer	6.6%	7.7%	8.7%	9.2%	7.9%	7.2%
Pancreas cancer	10.9%	10.5%	9.8%	6.4%	3.4%	2.4%
Oral cavity cancer	35.0%	39.8%	44.7%	50.7%	52.0%	54.0%
Myocardial infarction	8.0%	9.7%	11.8%	15.2%	15.4%	15.1%
Congestive heart failure	3.5%	3.8%	4.0%	2.5%	0.0%	0.0%
Stroke	8.9%	10.6%	12.4%	14.5%	13.5%	12.9%
COPD	26.4%	31.6%	37.8%	49.2%	52.3%	52.3%
Diabetes	0.8%	0.8%	0.8%	0.1%	0.0%	0.0%

The CDM estimates the future health care costs of the smoking related chronic diseases and for the entire health care sector in the Netherlands (all costs are indexed to the base year 2015). Table 3.4 presents the health care costs based on the smoking-related diseases and the health care costs caused by (all) other diseases. The number of smoking-related deaths is calculated by taking the population difference between two consecutive years minus the difference between the same consecutive years from the scenario in which smoking does not exist[3].

Table 3.4 Reference scenario: Health care costs in Million Euros and the number of smoking-related deaths

	2015	2017	2020	2030	2040	2050
Smoking-related diseases	8347	8230	8013	6886	5327	3879
Other diseases	90501	87578	83150	68346	53111	39600
Smoking-related deaths	14509	15928	17407	17687	9241	-377

Other smoking associated diseases

As described earlier, the CDM incorporates morbidity and mortality of 13 smoking-related chronic diseases. Selection criteria to incorporate smoking-related chronic diseases in the CDM were the most prevalent and most expensive chronic disorders, in order to make a reliable estimate of total health care costs due to certain risk factors in the Netherlands. Table 3.5 gives an overview of the top 10 most expensive and most prevalent disorders in the Netherlands [62]. For some disorders and diseases there is no (sufficient) evidence of a causal relationship with smoking [63] and others are already included within the CDM. However, current evidence shows that smoking also causes

[3] In a world in which smoking does not exist, there are 0 smoking related deaths.

Alzheimer's disease (i.e. the most prevalent 'form' of dementia) and certain eye diseases (i.e. 'form' of facial disorders) [63]. Therefore, costs of both diseases will be estimated via the SCBA model.

Table 3.5 Top ten most expensive and most prevalent disorders in the Netherlands

Ranking	Most expensive	Most prevalent
1	Mental impairments (incl. Down syndrome)*	Osteoarthritis of the limbs*
2	Dementia (incl. Alzheimer and other causes)***	Diabetes Mellitus**
3	Symptoms and ill-defined disorders*	Hearing disorders*
4	Dental diseases*	Neck and back pain*
5	Stroke**	Coronary heart diseases**
6	Coronary heart diseases**	Asthma**
7	Diabetes Mellitus including diabetic complications**	COPD**
8	Depression*	Contact eczema*
9	Asthma and COPD**	Facial disorders (i.e. macular degeneration***, glaucoma*, cataracts*** and retinopathy*)
10	Back problems*	Mood disorders*

* No or insufficient evidence for causal relationship with smoking
** Incorporated within CDM
*** Causal relationship with smoking and not incorporated within CDM

Alzheimer disease

The surgeon general report presents the health and financial burdens caused by tobacco use since 1964 [63]. One of these health burdens caused by tobacco use is Alzheimer's disease (54). Alzheimer, the most common type of dementia accounting for 70% of dementia cases, causes problems with memory, thinking and behaviour [64]. Those with Alzheimer's live an average of eight years after their symptoms become noticeable to others, but survival can range from four to 20 years, depending on age and other health conditions [65].

In 2011, the prevalence in the Netherlands of patients suffering from Alzheimer's disease was 0.3% of the population, or 46,000 patients [66]. The incidence of Alzheimer's disease in 2011 was 9,000 patients [66], as estimated from data from general practitioner registries in the Netherlands. According to the Dutch Alzheimer Association (Alzheimer Nederland), this is a severe underestimation [67]. They argue, based on population screening programs that the prevalence of Alzheimer's patients in the Netherlands was over 1.1% of the population, or 182,000 patients, in 2011. According to the World Health Organization (WHO), 14% of Alzheimer's disease cases are attributed to smoking [68]. For the calculation of current and future Alzheimer prevalence in this SCBA, it is assumed that the number of Alzheimer's disease patients is affected in two ways. First, a decrease in the number of people who smoke will cause less Alzheimer's disease patients due to smoking. Second, a decrease in the number of people who smoke will lead to a longer life expectancy, and therefore a higher number of Alzheimer's disease patients due to aging.

In 2011, the Dutch government spent €4.8 billion on dementia-related health care services, which translates into 24% of the mental health care budget and 5.3% of the total health care budget.
A recent study (2013) into the costs of dementia, estimated the total health care costs at €30,829 (€26,140 price index year 2005) per patient [69]. Data from the Ministry of Health, Welfare and Sport from 2011 estimate the total health care costs of Alzheimer at €55,175 (€51,692 price index year 2011) [70]. For this report, we will assume the average total health costs of an Alzheimer patient to be the mean between these two sources (€43,002[4]).

In calculating smoking-related health care costs due to Alzheimer, we divided prevalence data into smokers and non-smokers. All people have a risk of contracting Alzheimer's disease, increasing with age. Furthermore, people who smoke have an additional risk on Alzheimer's due to smoking, regardless of age. The table below presents the number of Alzheimer's patients and related health care costs in million euros. Two groups are presented: prevalence of smokers and non-smokers with Alzheimer. The group of smoking patients with Alzheimer splits into attributable to smoking and attributable to other factors.

Table 3.6 Reference scenario: Number of Alzheimer patients and smoking-attributable health care costs (Million €))

	2015	2017	2020	2030	2040	2050
Non-smoking Alzheimer patients	46814	49787	54309	70797	81570	85370
Smoking Alzheimer patients	10584	10841	11245	12457	12547	11741
Attributable to smoking	6304	6280	6232	6000	5836	5772
Attributable to other factors	4279	4561	5013	6457	6712	5970
Non-smoking Alzheimer costs	€ 2.013	€ 2.018	€ 2.015	€ 1.954	€ 1.675	€ 1.305
Smoking Alzheimer costs	€ 455	€ 439	€ 417	€ 344	€ 258	€ 179
Attributable to smoking	€ 271	€ 255	€ 231	€ 166	€ 120	€ 88
Attributable to other factors	€ 184	€ 185	€ 186	€ 178	€ 138	€ 91

Eye diseases

According to the surgeon general report 2014 [63], the evidence is sufficient to infer a causal relationship between cigarette smoking and eye diseases such as age-related macular degeneration (AMD) and cataract (in this report, eye disease consists of AMD and cataract) [63]. AMD is a medical condition that may result in blurred or no vision in the centre of the visual field. Age-related macular degeneration is the leading cause of severe and irreversible vision loss in the Western world. In the Netherlands, about 1.4% of people between 70-80 years suffer from AMD [71] A meta-analysis on smoking and the risk of AMD showed that 18% of AMD is attributable to smoking [71].

[4]Calculation: (€30,829+€55,175)/2

A multinational study of economic burden in AMD conducted in five countries, found that the average annual costs for patients with AMD varied from €6,251 (€5,300 in 2005) per patient (lowest) in the United Kingdom (UK) to €14,677 (€12,445 in 2005) per patient (highest) in Germany [72]. No data are available for the Dutch context. Therefore, it is assumed that the average annual total costs for AMD in the Dutch context is an average of the multinational study of economic burden in AMD resulting in €10,464 per patient[5].

A cataract is a clouding of the lens in the eye leading to a decrease in vision. It can affect one or both eyes. Not much is known on the proportion of cataract caused by smoking, but according to a very recent article on cataracts in adults, approximately 20% of cataract cases are attributable to smoking in the United States population. In 2011, cataract was one of the major cost categories in visual impairments, accounting for 562 million euros in the Netherlands [73]. The costs of cataract in 2011 were 19.9% of the total costs of visual impairments. On January 1st 2011, the point prevalence of cataract was 194,700, resulting in average annual costs for patients with cataract of €3,080 (€2,886 price index year 2011) [73].

In calculating the costs of eye disease due to smoking, we divided prevalence data into smokers and non-smokers. All people have a risk of both cataract and AMD, increasing with age. Furthermore, people who smoke have an additional risk of eye disease due to smoking, regardless of age. The table below presents the number of eye disease patients and related health care costs in million euros. Two groups are presented: prevalence of smokers and non-smokers with eye disease. The group of smoking patients with eye disease splits into attributable to smoking and attributable to other factors.

Table 3.7 Reference scenario: Number of eye disease patients and smoking-attributable health care costs (Million €)

	2015	2017	2020	2030	2040	2050
Non-smoking eye disease patients	57576	60958	65950	82356	91832	93152
Smoking eye disease patients	17967	18281	18712	19605	19207	18071
Attributable to smoking	11395	11352	11265	10845	10549	10433
Attributable to other factors	6571	6929	7447	8760	8658	7638
Non-smoking eye disease costs	€ 393	€ 392	€ 388	€ 360	€ 299	€ 226
Smoking eye disease costs	€ 120	€ 115	€ 108	€ 84	€ 61	€ 43
Attributable to smoking	€ 75	€ 70	€ 64	€ 46	€ 33	€ 24
Attributable to other factors	€ 45	€ 45	€ 44	€ 38	€ 28	€ 19

[5] Calculation: (€6,251+€14,677)/2

3.3 Consumer surplus

Consumer surplus is an economic measure of consumer satisfaction, which is calculated by analysing the difference between what consumers are willing to pay for a good or service relative to its market price. A consumer surplus occurs when the consumer is willing to pay more for a given product than the current market price, under the condition that the choice of buying a product is fully rational and out of free will. By contrast, a large body of empirical evidence from cognitive behavioural sciences demonstrates that smokers smoke because they are addicted and overestimate their ability to quit in the future [74]. In addition, there is no empirical evidence that suggests that persons who start smoking engage in deliberate decision-making processes in which they evaluate risks against benefits [75].

Therefore, analysts have taken a number of approaches for dealing with market goods for which persons may be psychologically or physically addicted. These range from treating them as if they were non-addictive to treating them as if they involved people imposing externalities on their future selves, so-called internalities [76].

Weimer et al. suggest adjusting the consumer surplus with the willingness of individual smokers to pay (WTP) to eliminate their addiction. Their estimates corresponded to 30-40% of the total consumer surplus which was estimated for their population [13]. Hence, this suggests that only between about 60-70% of the consumer surplus in the cigarette market should be counted as actual value for consumers [77]. Similar studies were conducted among Mexican smokers [78] and an older study among US smokers [79].

The actual consumer surplus for consumption is difficult to measure. To give an estimate of the consumer surplus in the reference scenarios, the consumer surplus was based on the price elasticity of cigarettes, which is -0.4 [80]. This means that for each 10% increase in retail prices, consumption decreases by about 4%. Then, we can (hypothetically) estimate how high prices must increase to create a situation in which everybody will stop buying cigarettes. Assuming a linear correlation, prices must increase with 50%, equivalent to a price increase from €6.20 to €21.70 per package[6]. In this case, the maximum consumer surplus is €15.50 per package, while the mean consumer surplus is estimated to be €7.75 per package. Following the recommendation of Weimer et al. (i.e. to adjust consumer surplus to 60-70%), in the reference scenario we take a mean correction factor of 65%, and estimate consumer surplus as 0.65*€7.75= €5.04 per package.

[6] Price of €6.20 is based on a package of Marlboro cigarettes, containing 19 cigarettes in 2015. A price increase of 250% is equal to €15.50, so the new price will be €15.50+€6.20 = €21.70.

Most smokers smoke cigarettes[7], and on average a smoker smokes 13 cigarettes per day [81]. To estimate total consumer surplus, we assume that a smoker will smoke 13 cigarettes per day and that this will not change over the years. This assumption means that the total consumer surplus is directly related to the number of smokers at a given time point in the population. The total consumer surplus in 2015 of the smoking population in the reference scenario can then be estimated to be €4,315 million[8] (see table 3.8).

Table 3.8 Reference scenario: Discounted total consumer surplus in Million Euros

	2015	2017	2020	2030	2040	2050
Consumer surplus	4315	4052	3680	2636	1908	1404

3.4 Quality Adjusted Life Year (QALY)

An important aspect of smoking is its association with Quality of Life (QoL) [82-84]. QoL is estimated in Quality Adjusted Life Years (QALYs). A QALY is a generic measure related to disease burden, including both the quality and the quantity of life lived. One QALY equates to one year in perfect health. Smoking has an impact on QALYs in two direct ways: 1) people die due to smoking, and 2) smoking decreases QoL in current and ex-smokers via smoking attributable diseases. Furthermore, smoking also has an impact on QALYs via one indirect way: by means of lowering/ reducing life expectancy.

The value of one QALY can be estimated based on two approaches. First, to ask respondents about their willingness to pay for small health increases using stated preferences techniques. Second, to use the monetary value of preventing fatalities; the value of a statistical life. Based on the evidence in the literature [85], the Dutch manual for SCBA in the social domain [18] recommends to use both €50,000 and €100,000 per QALY. The CDM provides an estimate of the total number of QALYs in the population in future years. The total number of QALYs is estimated based on all diseases (i.e. not only the smoke-related chronic diseases) and overall mortality within the population. Estimation of the total number of QALYs and their monetary values for the reference scenario can be found in table 3.9.

[7] Only about 17% of the smokers use fine cut tobacco in order to roll their own or for homemade cigarettes
[8] Calculation reasoning is as follows: 13 cigarettes per day*365 days= 4,745 cigarettes per year / 19 = 250 cigarette packages per year per smoker * the number of smokers in the Netherlands in a year *€5.04.

Table 3.9 Reference scenario: Total QALYs and their monetary value in Billion Euros (€)

	2015	2017	2020	2030	2040	2050
Number QALYs	13,910,896	13,971,734	14,045,408	14,155,515	14,100,665	13,991,492
Value €50,000	€696	€658	€606	€454	€337	€249
Value €100,000	€1,391	€1,317	€1,212	€909	€673	€497

3.5 Productivity

Productivity losses will be calculated following the SCBA instruction [18].
As described above, change in quality of life should be valued via the willingness to pay for a QALY. Better (or worse) health can also lead to other indirect effects that are not valued within the QALY, such as productivity and free time. However, because it is usually unknown to what extent the total amount of time available for work and leisure increases because of better health [18], it is a practical assumption that the increase of time is offset by exactly the reduction of the transfers. Therefore, this change in utility does not have to be valued separately. For the SCBA, only the change in QALYs needs to be valued.

From a societal viewpoint, the benefits of production minus the costs of consumption, which is paid by society, should be taken into account. Following this viewpoint, extra tax payments plus received transfer costs and social health care costs should be taken into account (see appendix F).
To estimate the total cost of productivity losses due to smoking in the reference scenario, we need to combine information on the total labour force in the Netherlands, transfer costs and gross (average) wages, levels of absenteeism and premature mortality due to smoking, and smoking prevalence in the Netherlands. The costs of transfers, gross average wages and levels of tax and social insurances can be found in Appendix F. The smoking prevalence within the population and mortality due to smoking is estimated by the CDM.
Levels of productivity losses are based on two direct routes: 1) when productivity is affected by absenteeism and presenteeism due to smoking, and 2) smoking-related deaths before retirement. Furthermore, productivity can also be impacted through an indirect route: when productivity (absenteeism and presenteeism) is reduced via smoking related chronic diseases.

Direct route absenteeism and presenteeism

A recent meta-analysis reported that smoking employees have substantially greater absenteeism than non-smoking employees. They report that smokers miss more workdays than non-smokers due to illness, ranging from 0.24 to 14.1 days, with an average of 2.74 days [86]. When comparing ex-

smokers with never smokers, some report significantly more days absent from work, others report no significant differences. There is conflicting evidence that ex-smokers are absent for longer spells than never smokers [86] and therefore, we assume that ex-smokers are not more often absent than never smokers.

Another cost to employers from smoking is presenteeism, which is lower productivity that results from nicotine addiction while being present at work. Though all employees are occasionally unproductive in one way or another, research suggests that smoking status negatively impacts productivity separately. Previous studies have found that the amount of time lost to unsanctioned smoking breaks ranges from 8 to 30 minutes per day[9] [87].

To estimate the costs of absenteeism and presenteeism, we take only transfer costs into account as explained earlier. Regarding sickness and smoking breaks, these transfers exist of the labour costs[10] as paid by the employer without any production by the employee in return. The production costs due to absenteeism and presenteeism are respectively €511[11] and €1,682[12] per smoker per year (price index year 2015).

Direct route productivity transfers and (old age-) pensions transfers

The CDM provides information about the smoking related mortality in the Dutch population. With this, the CDM can be used to provide information on the total labour force in the Netherlands[13]. Based on these population numbers, we can estimate the transfers paid by the labour force and received by persons not participating in the labour market. Again, only the transfers are estimated to give an overview of the paid transfers by society and the transfers received by persons in society (see table 3.10).

In productivity transfers are all transfers paid and received by the labour force or persons not at retirement age are estimated. For example, paid transfers are health care premiums, state pension premiums, pension premiums, and other taxes and social security contributions (see appendix F). Received transfers are incomes from social security.

(Old age-) pensions transfers are all transfers paid and received by persons at retirement age. Paid transfers are, for example, taxes on income due to pension. Received transfers are pensions (see appendix F).

[9] The average time that smokers take daily for their smoking breaks is estimated to be (8+30)/2= 19 minutes, this leads to 9.03 work days lost due to presenteeism per year.

[10] These labour costs pertain to (gender, age, and full-time/part-time share) average gross wage (€41,363) and based on 228 workdays per year (see appendix F).

[11] Calculation: 2.74 days/228 workdays per year*€41,363 (see appendix F).

[12] Calculation: 9.025 days/228 workdays per year*€41,363 (see appendix F).

[13] Population between 15-67 years *net participation rate (see appendix F).

Indirect route morbidity

Smoking is a risk factor for (chronic) diseases and these diseases have impact on productivity. Lost productivity due to these diseases can be estimated via QALY changes, assuming a decrease in QALYs will lead to productivity losses. The relationship between changes in QALYs and changes in productivity can be estimated from the Nemesis-2 data by regression analysis. The Nemesis-2 study is a population-based epidemiological cohort study (n=6,646) and provides data on 4,503 people aged 18-65 years in the Dutch labour force (i.e. with paid work for more than 12 hours per week) of which there is data on absenteeism, presenteeism and utilities [3]. The estimated levels of workforce participation from Nemesis-2 is crosschecked with data from Statistics Netherlands [88], and absenteeism and presenteeism are measured with the WHO Disability Assessment Schedule [89]. The QALYs are derived from the SF-36 [90] using Brazier's algorithm [91]. The number of work loss days (i.e. absenteeism plus presenteeism) is estimated based on the number of QALYs (see Table 3.10), by means of a regression analysis.

Table 3.10 QALYs and the related number of work loss days, existing of absenteeism and presenteeism days per year

QALY	Work loss days	Absenteeism	Presenteeism
0.000	206	146	59
0.050	192	136	56
0.100	178	125	52
0.600	150	105	45
0.656	23	11	12
0.710	8	0	8
0.738	0	-6	6
0.800	-17	-19	1
0.900	-45	-39	-6
0.950	-59	-50	-9
1.000	-73	-60	-13

Again, to estimate the costs of the work loss and sick leave days, we take only transfer costs into account. In case of the work loss days, these transfers cost are present in the total labour costs[14] as these are being paid by the employer without any production by the employee in return. To calculate the production costs due to work loss days and presenteeism based on the number of QALYs, the difference in average QALY[15] per person within the labour force population[16] are multiplied by the total labour force population, the estimated mean work loss days[17] and the cost per work day lost.

[14] These labour costs pertain to (gender, age, and full-time/part-time share) average gross wage (€41,363) and based on 228 workdays per year.
[15] Based on the difference of the average number of QALYs per person in the reference scenario compared to the estimated scenario in which tobacco does not exist.
[16] The participation grade (73.6%) of the population aged between 15 to 67 years.
[17] Based on Table 3.9 the difference between a QALY value of 0 and 1 is 279 work days.

Table 3.11 gives an overview of the transfers related to production and productivity losses for both the direct and indirect routes. Negative values signify costs to society in the reference scenario; positive values signify gains/benefits to society.

Table 3.11 Reference scenario: Production transfers per year

	2015	2017	2020	2030	2040	2050
Direct route						
Absenteeism and presenteeism	7515	7057	6408	4591	3323	2445
Productivity transfers	186484	176677	162451	120264	88600	66131
(Old age-) pensions	41208	41120	40230	35571	28328	20043
Indirect route						
Absenteeism and presenteeism	5598	5272	4823	3472	2633	1913
Total transfers	240805	230126	213913	163897	122884	90532

3.6 Government

Excise tax is a stable source of income for the government. All excise taxes together (i.e. oil, alcohol, tobacco, etc.) are about 8% of the total government income via taxes. The government will adjust taxes in other domains to compensate for the loss/gain in excise tax. In addition, one should be aware of the losses (or gains) in the value-added tax (VAT) paid for the excise tax and the amount of VAT that would have been paid for the total amount. Hence, it has been estimated that any loss or gain in excise tax should be multiplied by 1,42 (42%), to compensate for these effects [18].

Although in previous years, excise tax on tobacco has been increased regularly and the prevalence of smokers is declining, the total revenues based on excise tax are still increasing. This can be explained by the price elasticity of tobacco, which is -0.4 [80]. This means that for each 10% increase in retail prices, consumption decreases by about 4%. For a very long time, increasing excise tax will lead to increased revenues for the government [92].

Within the reference scenario, the government income from excise taxes is based on projections of the proportional decline in prevalence smokers in future years. The starting point is the total government income of excise tax in 2015, which is assumed to be equal to the government income in 2014, for which we had the most recent data [93]. In the reference scenario we assume that prices and taxes for tobacco remain constant over the years. Due to the projected decline in smoking prevalence within the reference scenario and without any increased tax policies, we estimate that the government incomes will decrease in future years from €3,737 million in 2015 to €1,216 million by 2050 (see Table 3.12).

Table 3.12 Reference scenario: Government income; excise tax and VAT of tobacco products per year in million Euros

	2015	2017	2020	2030	2040	2050
Excise tax	2632	2471	2244	1608	1164	856
Total incl. correction factor	3737	3509	3187	2283	1652	1216

3.7 Producer surplus

Producer surplus arises from the production of tobacco leaf and from the manufacturing of cigarettes. For producers, economists can approximate the benefits by examining the relationship between the market price of a good and the amount of it supplied (supply-elasticity). This is called producer surplus, and is calculated by estimating how much money could be taken from producers without reducing the amount that they would supply. As a measure of economic profits, producer surplus is the revenue minus the opportunity costs, also equivalent to economic rent.

As the last cigarette manufacturing plant was closed in the Netherlands in 2014, producer surplus from cigarette producers is therefore not taken into account in this SCBA. However, to our current knowledge there are still four tobacco companies left in the Netherlands[18], three of which produce fine cut tobacco and cigars. These companies are responsible for about 1470 jobs[19] [94]. Furthermore, the SCBA guideline states that the producer surplus is not relevant for an SCBA when there is enough competition within the market and if one does not directly intervene within the market [14]. Hence, the decrease of the producer surplus in one sector is expected to be compensated for by an increase in producer surplus of the same order of magnitude for other sectors, when consumers start consuming different goods to a greater extent. Hence, we assume that the savings that consumers realize as a consequence of buying and consuming less cigarettes is used for other consumption. Even if there is a ‘large' producer surplus, it is likely that this will be reached in other markets when production shifts. Besides this, the proposed policies in this SCBA are directly focused on the demand side of tobacco products, not on the supply side and therefore, only indirect effects on the producer surplus are expected. Hence, effects on producer surplus are not estimated nor monetised in this SCBA report.

3.8 Labour Market

Tobacco control policies can have indirect consequences for the labour market. The SCBA guidelines state that when there are only indirect effects on the labour market, most of these policies will only

[18] A fine cut tobacco plant from Imperial Tobacco in Joure, a fine cut tobacco plant of Niemeyer British American Tobacco in Groningen, a fine cut tobacco plant of Heupink & Bloemen Tabak bv in Ootmarsum and a sales organization of tobacco products of Landewyck Tabak Holland, in Roosendaal.

[19] The Dutch tobacco industry has, according to the CBS, in 2013, 2700 employees. As the Philip Morris plant was closed in 2014, 1230 employees lost their job.

lead to movements within the labour market [14]. Higher employability in a certain sector due to such policies is at the cost of lower employability in another sector. This means that indirect effects on the labour market are (mostly) temporarily and have, overall, no effect on national employment level. For example, there are about 600 pulmonologists in the Netherlands who are treating many smoking attributable diseases (e.g. COPD and lung cancer). When smoking prevalence decreases due to tobacco control policies, the incidence of lung cancer and COPD will decrease as well. This will lead to less lung patients and thus to a lesser demand for pulmonologists in the Netherlands. Hence, less medical students will be trained to become. Similar scenarios can be made for, for example, the retail industry selling tobacco products. Although there are not many shop owners focusing solely on the sale of tobacco products in the Netherlands, a decline in tobacco demand will lead to a shift in the supply of (other) goods. Therefore, effects on the labour market are not estimated nor monetised in this SCBA report.

3.9 Others in society

Insurances

These so-called transfer costs indicate that they do not signify additional economic costs but represent only a shifting or transfer of part of the cost of lost production from the individual or family to the taxpayer. As taxpayers have to pay for these transfer costs, they cannot spend that money on other goods, but others are benefitting from the transfer costs. Therefore, the society as a whole does not gain or lose due to transfer costs. In effect, transfer payments represent a reallocation of resources rather than a loss of resources. However, it can be valuable to gain insight into such transfer costs in order to specify costs and benefits for different stakeholders in society. Furthermore, in paragraph 3.5 'Production losses' transfer costs are used to estimate the productivity losses.

Fire damage

Insurance premiums may be higher because of fire damage claims due to smoking. In 2013, 14,326 indoor fires were registered in the Netherlands [95]. Of these indoor fires 6.7% were caused by smoking [96]. In 2008, 14,423 indoor fires resulted in €907 million fire damage claims [97]. If smoking no longer exists, 960 indoor fires could be prevented, with a mean fire damage claim per fire of €70,363 (price index year 2015)[20]. An estimate of the total costs due to indoor fires in future years

[20] €62,885 price index year 2008

reveals that the costs are relatively declining alongside the decreasing smoking prevalence in the Netherlands estimated for the reference scenario.

Table 3.13 Reference scenario: Total costs indoor fires due to smoking per year in Million Euros

	2015	2017	2020	2030	2040	2050
Total costs	60	57	51	37	27	20

Health effects of passive smoking

Smoking has consequences for others in society, such as passive smokers, unborn children and pregnant women.

The involuntary inhalation of tobacco smoke by non-smokers has been referred to as passive smoking. The smoke inhaled has been called second hand smoke or environmental tobacco smoke (ETS). The most important source of environmental tobacco smoke is exposure at home and in the car. In countries where there is no ban on smoking at work and other public places, those places are an important source for passive smoking [98]. In the Netherlands, 18-40% (15 years of age and higher) of non-smoking adults are exposed to ETS from other people and 20-36% of children (14 years of age and younger) are also exposed [99]. Young children are exposed most when their parent(s) smoke(s) [63, 100].

There are no recent reliable data on the exact contribution of passive smoking in the Netherlands. It is known that one in five (22%) Dutch inhabitants are affected by ETS in some way [4]. According to data from the Continuous Survey of Smoking Habits in the Netherlands study (2014) [61], Dutch inhabitants do care about smoking and passive smoking in and around the house. One-third of Dutch households have a no smoking policy at home, almost half of the people (47%) only allow smoking in the garden or on a balcony and the minority of people (7%) allows smoking everywhere in and around the house. In addition, the attitude of people towards smoking around children was investigated. About 90% of the people found it unacceptable to smoke in front of children (18 years of age or younger).

Though the exact health effects of passive smoking still lack conclusive evidence, exposure to ETS is likely to be the cause of many health problems. Besides indications of short exposure to ETS which may lead to irritated eyes and throat, coughing, nausea and dizziness [63], passive smoking is a risk factor for several diseases:

- According to a review conducted by the Surgeon General [63], the risk of lung cancer is increased by 20-30% in people who are exposed to ETS. Other research found a relative risk (RR) of 1.21 with regard to passive smoking and lung cancer [101].

- Strong evidence was found on the causal relationship between passive smoking and coronary heart disease. The risk of coronary heart disease, such as heart attack or angina pectoris, is 25-30% higher in passive smokers compared to none passive smokers [63]. Other research found a relative risk (RR) of 1.13-1.48 with regard to passive smoking and coronary heart disease [101].
- Recently, evidence was found on an increased risk of stroke. According to a review conducted by the Surgeon General, passive smokers have 20-30% more chance of receiving a stroke compared to none passive smokers [63]. Other research found a relative risk (RR) of 1.11-1.40 with regard to passive smoking and stroke [101].
- Also, passive smoking may increase the chances of getting respiratory conditions such as infections and other symptoms with 20-50% [63].
- Furthermore, there is evidence that passive smoking in mothers around children and babies may lead to lower respiratory diseases, asthma, hearing problems and decreased pulmonary function [63, 102].
- Furthermore, smoking, and therefore passive smoking, has a negative effect on fertility in both men and women [63]. There is a definite negative relationship between passive smoking and fertility in women, and it is assumed the same negative effects of passive smoking on fertility are applicable to men [63].

There are some leads indicating the relationship between passive smoking and nasal cancer, breast cancer, respiratory diseases, nasal irritation, diabetes and cognitive disorders, but evidence is very limited and inconclusive [63]. Hence, due to the lack of recent, reliable and conclusive data the effects we were unable to include passive smoking & smoking during pregnancy. However one may assume that when the prevalence of smoking decreases, these secondary effects will also decrease.

Passive smoking and mortality

There are no recent, reliable data concerning passive smoking and mortality in the Netherlands. According to an estimate by the Dutch Health Council in 2003 based on US parameters, annually a few thousand people die due to coronary diseases caused by passive smoking. Furthermore a few hundred cases of lung cancer and a dozen cases of sudden infant death syndrome are attributed to passive smoking [103].

Costs of passive smoking

It is very difficult to estimate the costs of passive smoking due to unavailability and inconclusiveness of data. There are no reliable data on the number of patients suffering from passive smoking related diseases, nor data on persons suffering from fertility problems due to passive smoking, nor on the

exact numbers of babies born premature or with a health condition due to (passive) smoking during pregnancy.

Following the estimates by the Dutch Health Council is reliable, it is possible to give a very rough indication of the annual costs caused by mortality in passive smoking: approximately €102 million per year[21].

This is probably a large underestimation of the real costs, as only an indication of the number of diseased persons due to passive smoking is taken into account. For example, (lifetime) costs of other chronic diseases that are attributable to passive smoking, such as respiratory problems in children and premature births, are not quantified. Furthermore, the evidence on this topic is insufficient to estimate future developments in terms of costs. Therefore, we are not able to predict the effect of a decrease in the proportion of smokers relative to society on health problems in passive smoking.

Smoking and pregnancy

A great amount of research has been done estimating the (negative) impact of smoking during pregnancy [104]. Recent research in the Dutch population has shown that in 2010, approximately 6.3% of all pregnant women smoked on a daily basis [105]. The Surgeon General provides an overview of evidence on the health effects of smoking in pregnant women [63]:

- Chances of miscarriage are increased by 30-100%
- Chances of ectopic pregnancy are increased by 80%
- Chances of placenta praevia are increased by 30-100%
- Chances of premature placenta abruption are increased by 40-90%
- Chances of premature birth are increased by 27%
- Chances of premature rupture of membranes is twice as high compared to non-smokers resulting in an increase of 100%

Furthermore, smoking during pregnancy has a severe impact on the development of both foetus and child [63]:

- There is sufficient evidence to state that smoking during pregnancy increases chances of infant death by 80-300%
- There is a 25% higher chance of birth defects such as a harelip and cleft palate in babies of women who smoke during their pregnancy.

[21] A few thousand cases of coronary diseases (~4000) and a few hundred cases of lung cancer (~400), combined with the costs of coronary disease (€25,269 per patient, price index year 2015) [104] and the costs of lung cancer (€19,455 per patient, price index year 2015) [105] would result in total costs of passive smoking of €101,986,800 per year.

- However, as the health effects of smoking during pregnancy are clear, evidence the health effects of passive smoking during pregnancy is limited. There is some preliminary evidence on the health effects of passive smoking in pregnant women:
- Evidence suggests that passive smoking in pregnant women leads to a higher risk (20-40%) of giving birth to babies with low birth weights (below 2500 grams) [63, 100]
- There are indications that passive smoking in pregnant women is associated with physical and neurobehavioral disabilities, premature birth, reduced lung function and cancer in children [102]
- Also, research shows higher chance of miscarriage, perinatal death and dysmaturity [102]

Environment

Smoking not only affects the smoker's health, it also greatly influences the surrounding atmosphere. Smoke and cigarette butts affect the environment, resulting into air, water and land pollution. It is quite evident that smoking causes air pollution. "De Rekenkamer" estimated that in 2005 31 trillion cigarettes were smoked, causing serious air pollution, comparable with the yearly greenhouse gas emissions from agriculture [106].

Furthermore, land and water are polluted by millions cigarette butts that are left on the ground. Fish and other water animals accidently eat these butts, resulting in their dead. When cigarette butts are not removed by cleaning services, they will take 2 years to decompose[107]. In 2011, it was estimated that in the Netherlands about 10 billion cigarette butts end up on the streets which corresponds to 27 million litres of waste per year. "De Rekenkamer" estimated that about 30% of the total litter cleaning is due to cigarette butts, which corresponds to €63.08 million (€59.1 million price index year 2011) [106].

Even a larger impact on the environment is due to the production of tobacco. The land that is used for the cultivation of tobacco plants is useless for cultivation of other crops after a number of years. The tobacco plants are highly susceptible to pests and disease, so to maintain their proper growth and health various chemicals and pesticides are being sprayed. The production and packaging of cigarettes requires a significant amount of trees. Tobacco leafs are dried by burning stone coal, gas, oil or wood. In developing countries, mostly wood is used and therefore, 2.5 million hectares of forest are cut down each year. This is almost half of the total area of the Netherlands. As the production of tobacco is executed outside the Netherlands, these costs are not taken into account in this SCBA.

The estimate of the environmental costs due to tobacco-related pollution in future years, reveals that the costs are relatively declining alongside the decreasing smoking prevalence in the Netherlands estimated for the reference scenario.

Table 3.14 Reference scenario: Total costs environment in million Euros

	2015	2017	2020	2030	2040	2050
Total costs	63	59	54	38	28	20

3.10 Overview cost and benefits

This paragraph will present an overview of all included costs and benefits related to smoking. As described previously, within the Netherlands, several stakeholders can be identified which may be impacted by smoking and smoking cessation. Hence, the overview of costs and benefits will be presented in combination to the stakeholders they apply to. These are consumers, producers, employers, others in society, health care, public authority (government), and taxes and duties.

Table 3.15 Reference scenario: Monetarised costs and benefits per year in million Euros

		2015	2017	2020	2030	2040	2050
Consumers	Value of total QALYs (€50.000)	695,545	658,485	605,785	454,294	336,728	248,617
	Value of consumer surplus	4315	4052	3680	2636	1908	1404
Producers	Producer surplus	p.m.	p.m.	p.m.	p.m.	p.m.	p.m.
Employers	Absenteeism and presenteeism	7515	7057	6408	4591	3323	2445
	Absenteeism due to chronic diseases	5598	5272	4823	3472	2633	1913
Others in society	Fire damage costs	60	57	51	37	27	20
	Environmental costs	63	59	54	38	28	20
Health care	Smoking related health care costs	8347	8230	8013	6886	5327	3879
	Other diseases health care costs	90501	87578	83150	68346	53111	39600
	Smoking related Alzheimer costs	271	255	231	166	120	88
	Smoking related eye disease costs	75	70	64	46	33	24
Public Authority	Intervention costs	0	0	0	0	0	0
	Enforcement costs	p.m.	p.m.	p.m.	p.m.	P.m.	p.m.
Taxes and duties	Government income	3737	3509	3187	2283	1652	1216
	(Old-age-) pensions transfers	41208	41120	40230	35571	28328	20043
	Productivity transfers	186,484	176,677	162,451	120,264	88,600	66,131

3.11 The impact of discounting

According to the Dutch guidelines, all costs and benefits occurring after one year need to be discounted at 3% [14, 60]. However, this may lead to confusion as it appears that costs will decrease in the future when in fact this is caused by the discount rate. Hence, one should be aware that all costs presented in this report are discounted. To demonstrate this difference, we presented the undiscounted costs and benefits of the reference scenario in table 3.16. As can be seen from table

3.15 and 3.16, the smoking-related costs will increase over time and the apparent decrease in smoking-related costs in table 3.15 is caused solely by the discount factor. One should be aware that in the remainder of this report, only discounted values are used.

Table 3.16 Reference scenario: Undiscounted monetarised costs and benefits per year in million Euros

		2015	2017	2020	2030	2040	2050
Consumers	Value of total QALYs (€50.000)	695,545	698,587	702,270	707,776	705,033	699,575
	Value of consumer surplus	4315	4299	4266	4107	3995	3951
Producers	Producer surplus	p.m.	p.m.	p.m.	p.m.	p.m.	p.m.
Employers	Absenteeism and presenteeism	7515	7486	7429	7152	6957	6881
	Absenteeism due to chronic diseases	5598	5593	5591	5409	5513	5383
Others in society	Fire damage costs	60	60	60	57	56	55
	Environmental costs	63	63	62	60	58	58
Health care	Smoking related health care costs	8347	8731	9289	10729	11153	10915
	Other diseases health care costs	90,501	92,911	96,394	106,481	111,203	111,428
	Smoking related Alzheimer costs	€ 271	€ 270	€ 268	€ 258	€ 251	€ 248
	Smoking related eye disease costs	€ 75	€ 75	€ 74	€ 71	€ 69	€ 69
Public Authority	Intervention costs	0	0	0	0	0	0
	Enforcement costs	p.m.	p.m.	p.m.	p.m.	p.m.	p.m.
Taxes and duties	Government income	3737	3723	3695	3557	3460	3422
	(Old-age-) pensions transfers	41208	43625	46638	55418	59313	56398
	Productivity transfers	186,484	187,436	188,325	187,367	185,508	186,083

3.12 Sensitivity analyses

Probabilistic and one-way sensitivity analyses were performed to estimate the impact of uncertainty in model parameters. Probabilistic sensitivity analysis was based on the uncertainty regarding the development of the distribution of risk classes in the population throughout the time horizon of 35 years, as captured in the CDM. This results in one hundred random draws from the underlying distributions, resulting in one hundred possible risk class distributions, health care cost estimates, and quality of life estimates, over the time horizon of 60 years. Subsequently, outcomes in the SCBA are reported with 95% confidence intervals, representing the uncertainty in the outcomes as a result of the uncertainty in the underlying input parameters.

Probabilistic sensitivity analyses

Table 3.17 Confidence intervals (CI) for the reference scenario based on PSA per year (in millions)

		2015	2017	2020	2030	2040	2050
Consumers	Base case	699860	662537	609464	456930	338636	250021
95%CI	Lower bound	698567	660995	607639	454707	336495	248225
	Upper bound	700267	663027	610055	457693	339337	250630
Producers	Base case (Fixed)	P.m.	P.m.	P.m.	P.m.	P.m.	P.m.
Employers	Base case	13113	12329	11232	8062	5956	4358
95%CI	Lower bound	12770	11949	10806	7573	5482	3933
	Upper bound	13339	12568	11494	8321	6169	4538
Others in society	Base case	123	116	105	75	54	40
95%CI	Lower bound	123	116	105	75	54	40
	Upper bound	123	116	105	75	55	40
Health care	Base case	99194	96132	91458	75444	58591	43591
95%CI	Lower bound	98894	95788	91071	75002	58174	43311
	Upper bound	99514	96531	91933	76045	59252	44189
Public authority	Base case (Fixed)	0	0	0	0	0	0
Taxes and duties	Base case	231429	221307	205868	158118	118580	87390
95%CI	Lower bound	231094	220929	205397	157491	117950	86860
	Upper bound	231598	221521	206145	158500	119008	87789

4. Part I Alternative scenario: Single policies

Chapter 4 describes the single policy scenarios Tax increase and Mass Media Campaigns.

An overview of the structure of Chapter 4 can be found in Figure 4.1.

Figure 4.1 Overview Chapter 4: Single policies

4.1	Increasing excise tax	
	4.1.1	Methods
	4.1.2	Smoking prevalence
	4.1.3	Health care impact
	4.1.4	Consumer surplus
	4.1.5	Quality adjusted life years
	4.1.6	Productivity
	4.1.7	Government
	4.1.8	Others in society
	4.1.9	Intervention costs
	4.1.10	Net present value
	4.1.11	Cumulative net present value
	4.1.12	Sensitivity analyses
4.2	Mass Media Campaigns	
	4.2.1	Methods
	4.2.2	Smoking prevalence
	4.2.3	Health care impact
	4.2.4	Consumer surplus
	4.2.5	Quality adjusted life years
	4.2.6	Productivity
	4.2.7	Government
	4.2.8	Others in society
	4.2.9	Intervention costs
	4.2.10	Net present value
	4.2.11	Cumulative net present value
	4.2.12	Sensitivity analyses

4.1 Increasing excise tax

The goal of tobacco taxation is to make tobacco products progressively less affordable. This means that governments must increase taxes annually to ensure that real price increases rise faster than consumer purchasing power and that tax rates are increased for all tobacco products.
Raising the price of tobacco and tobacco products through tax increases is the most effective way to reduce smoking. Higher cigarette prices reduce the number of smokers and induce those who continue to smoke to consume fewer cigarettes per day. It is estimated that for each 10% increase in retail prices, consumption is reduced by about 4% in high-income countries and by about 8% in low- and middle-income countries [108].

4.1.1 Methods

Total price elasticity is the sum of reduced smoking due to drops in smoking prevalence and effects on tobacco consumption of continuing smokers. Therefore, it is crucial what percentage of total price elasticity is the result of a decrease in smoking prevalence.
Total price elasticity needs to be decomposed into effects on smoking prevalence (prevalence elasticity or participation elasticity) and effects on the amount of cigarettes smoked per person (quantity elasticity of smoking intensity). Several studies have concluded that minimally half of the decrease in tobacco sales can be explained by a decrease in smoking prevalence [80]. The other half in decrease in consumption is the result of smokers who cut their level of tobacco consumption. Thus, it is assumed that the total price elasticity of demand for tobacco equals -0.4. The amount that is caused by an increase in quitting rates among smokers is set on 50% (prevalence elasticity= -0.2; quantity elasticity of smoking intensity= -0.2). By using this conservative price elasticity, substitution effects towards fine cut tobacco or homegrown tobacco are taken into account.
It is important to note that the effect of prevalence elasticity is not linear. Over time, the prevalence elasticity will decrease, however due to the complexity of the model and the annual changes in the transition rates, the absolute decrease in smoking prevalence is difficult to point out. In addition, the start-, stop-, and relapse-rates are adjusted with this constant -0.2 per year, making the yearly decrease more difficult to point out.
To model the effects of price increases with the Chronic Diseases Model (CDM), we will assume a yearly tobacco tax increase of 5% from 2017 onwards, which will result in a yearly price increase of 3.4% from 2016 to 2017 ascending to 4.56% from 2049 to 2050 (see Table 4.1 and appendix G), assuming that producers do not adjust their prices in reaction.
Furthermore, we will calculate the effects of a 10% annual tobacco tax increase, this will result in a yearly price increase of 6.7% from 2016 to 2017 ascending to 9.8% from 2049 to 2050 (see Table 4.2

and appendix G), again assuming that producers do not adjust their prices in reaction. These prices are not corrected for future inflation.

Table 4.1 Projected costs of cigarettes with 5% yearly tax increase

	2015	2017	2020	2030	2040	2050
Minimum tax 1000 cigarettes	€181.53	€190.61	€243.27	€359.42	€585.45	€953.64
Minimum tax pack 19 cigarettes	€3.45	€3.62	€4.19	€6.83	€11.12	€18.12
Trading margin*	€1.67	€1.67	€1.67	€1.67	€1.67	€1.67
VAT pack 19 cigarettes	€1.08	€1.11	€1.23	€1.78	€2.69	€4.16
Total cost	€6.20	€6.40	€7.09	€10.28	€15.48	€23.95
% tax of total cost	55.7	56.6	59.1	66.4	71.4	75.7
% tax+VAT of total cost	73.0	73.9	76.4	83.8	89.2	93.0
% price increase	0.00	3.37	3.52	3.98	4.32	4.56

*estimated from Marlboro cigarette pack 19 pieces 2015, kept constant in projected years

Table 4.2 Projected costs of cigarettes with 10% yearly tax increase

	2015	2017	2020	2030	2040	2050
Minimum tax 1000 cigarettes	€181.53	€199.68	€265.78	€689.36	€1788.02	€4637.67
Minimum tax pack 19 cigarettes	€3.45	€3.79	€5.05	€13.10	€33.97	€88.12
Trading margin*	€1.67	€1.67	€1.67	€1.67	€1.67	€1.67
VAT pack 19 cigarettes	€1.08	€1.15	€1.41	€3.10	€7.49	€8.86
Total cost	€6.20	€6.61	€8.13	€17.87	€43.13	€108.64
% tax of total cost	55.7	57.4	62.1	73.3	78.8	81.1
% tax+VAT of total cost	73.0	74.7	79.5	90.6	96.1	98.5
% price increase	0.00	6.74	7.33	8.77	9.49	9.80

*estimated from Marlboro cigarette pack 19 pieces 2015, kept constant in projected years

4.1.2 Smoking prevalence

If an annual tax increase of 5% will be implemented, adult smoking is projected to decrease from 19.8% from 2015, to 19.6% by 2017, to 19.2% by 2020, to 17.6% by 2030, to 16.2% by 2040 and to 15.1% by 2050 (See Table 4.3).

Table 4.3 Scenario 5% tax increase: Gender specific smoking prevalence projections

	2015	2017	2020	2030	2040	2050
Male smokers	21.9%	21.6%	21.1%	19.4%	17.8%	16.6%
Female smokers	17.8%	17.6%	17.3%	15.8%	14.6%	13.6%
All smokers	19.8%	19.6%	19.2%	17.6%	16.2%	15.1%
Male ex-smokers	28.9%	28.7%	28.4%	27.0%	25.1%	23.5%
Female ex-smokers	29.0%	28.9%	28.6%	27.3%	25.0%	22.6%
All ex-smokers	28.9%	28.8%	28.5%	27.2%	25.1%	23.1%
Male never smokers	49.2%	49.7%	50.5%	53.7%	57.1%	59.9%
Female never smokers	53.2%	53.5%	54.1%	56.8%	60.4%	63.9%
All never smokers	51.2%	51.6%	52.3%	55.3%	58.7%	61.9%

When an annual tax increase of 10% will be implemented, adult smoking is projected to decrease from 19.8% from 2015, to 19.6% by 2017, to 19.2% by 2020, to 17.1% by 2030, to 14.9% by 2040 and to 12.7% by 2050 (See Table 4.4).

Table 4.4 Scenario 10% tax increase: Gender specific smoking prevalence projections

	2015	2017	2020	2030	2040	2050
Male smokers	21,9%	21,6%	21,1%	18,8%	16,3%	13,9%
Female smokers	17,8%	17,6%	17,2%	15,4%	13,4%	11,5%
All smokers	19,8%	19,6%	19,2%	17,1%	14,9%	12,7%
Male ex-smokers	28,9%	28,7%	28,4%	27,2%	25,6%	24,2%
Female ex-smokers	29,0%	28,9%	28,7%	27,6%	25,5%	23,1%
All ex-smokers	28,9%	28,8%	28,5%	27,4%	25,5%	23,6%
Male never smokers	49,2%	49,7%	50,5%	54,0%	58,1%	61,9%
Female never smokers	53,2%	53,5%	54,1%	57,1%	61,1%	65,5%
All never smokers	51,2%	51,6%	52,3%	55,6%	59,6%	63,7%

4.1.3 Health care impact

Table 4.5 presents the prevalence of smoking-related diseases within the entire population, estimated for future years with a 5% tax increase tobacco control policy.

Table 4.5 Scenario 5% tax increase: Prevalence* of smoking-related diseases

Chronic diseases	2015	2017	2020	2030	2040	2050
Lung cancer	0.22%	0.22%	0.23%	0.25%	0.24%	0.21%
Stomach cancer	0.04%	0.04%	0.04%	0.04%	0.05%	0.05%
Oesophagus cancer	0.05%	0.05%	0.05%	0.06%	0.06%	0.05%
Larynx cancer	0.05%	0.05%	0.05%	0.05%	0.05%	0.04%
Bladder cancer	0.12%	0.12%	0.13%	0.15%	0.16%	0.16%
Kidney cancer	0.12%	0.12%	0.12%	0.13%	0.14%	0.13%
Pancreas cancer	0.02%	0.02%	0.02%	0.03%	0.03%	0.03%
Oral cavity cancer	0.03%	0.03%	0.03%	0.03%	0.02%	0.02%
Myocardial infarction	4.01%	4.10%	4.23%	4.56%	4.63%	4.49%
Congestive heart failure	0.92%	0.96%	1.02%	1.24%	1.38%	1.42%
Stroke	1.37%	1.44%	1.54%	1.80%	1.90%	1.88%
COPD	2.55%	2.66%	2.83%	3.15%	3.11%	2.93%
Diabetes	5.50%	5.66%	5.87%	6.39%	6.56%	6.53%

* the prevalence refers to the total prevalence, attributable and non-attributable to smoking

Table 4.6 presents the prevalence of smoking-related diseases within the entire population, estimated for future years with a 10% tax increase tobacco control policy.

Table 4.6 Scenario 10% tax increase: Prevalence* of smoking-related diseases

Chronic diseases	2015	2017	2020	2030	2040	2050
Lung cancer	0.22%	0.22%	0.23%	0.25%	0.23%	0.21%
Stomach cancer	0.04%	0.04%	0.04%	0.04%	0.05%	0.05%
Oesophagus cancer	0.05%	0.05%	0.05%	0.06%	0.06%	0.05%
Larynx cancer	0.05%	0.05%	0.05%	0.05%	0.05%	0.04%
Bladder cancer	0.12%	0.12%	0.13%	0.15%	0.16%	0.16%
Kidney cancer	0.12%	0.12%	0.12%	0.13%	0.14%	0.13%
Pancreas cancer	0.02%	0.02%	0.02%	0.03%	0.03%	0.03%
Oral cavity cancer	0.03%	0.03%	0.03%	0.03%	0.02%	0.02%
Myocardial infarction	4.01%	4.10%	4.23%	4.56%	4.62%	4.47%
Congestive heart failure	0.92%	0.96%	1.02%	1.24%	1.38%	1.42%
Stroke	1.37%	1.44%	1.54%	1.80%	1.90%	1.88%
COPD	2.55%	2.66%	2.83%	3.15%	3.10%	2.89%
Diabetes	5.50%	5.66%	5.87%	6.39%	6.56%	6.53%

* the prevalence refers to the total prevalence, attributable and non-attributable to smoking

In table 4.7 and table 4.8 the health care costs based on the smoking-related diseases and the health care costs caused by (all) other diseases for the policy scenario with 5% and 10% tax increase are presented.

Table 4.7 Scenario 5% tax increase: Health care costs in absolute numbers (million Euros) and the number of smoking-related deaths per year

	2015	2017	2020	2030	2040	2050
Smoking-related diseases	8347	8230	8013	6884	5319	3862
Other diseases	90501	87578	83150	68347	53118	39621
Smoking-related deaths	14509	15928	17406	17643	9028	-900*

* Negative value because if people would never have smoked, they would have lived longer and would die later. Hence, the number of deaths in 2050 would be higher compared to a situation with smoking.

Table 4.8 Scenario 10% tax increase: Health care costs in absolute numbers (million Euros) and the number of smoking-related deaths per year

	2015	2017	2020	2030	2040	2050
Smoking-related diseases	8347	8230	8013	6883	5311	3846
Other diseases	90501	87578	83150	68348	53124	39641
Smoking-related deaths	14509	15928	17406	17600	8821	-1391*

* Negative value because if people would never have smoked, they would have lived longer and would die later. Hence, the number of deaths in 2050 would be higher compared to a situation with smoking.

In both scenarios where a tax increase is implemented, adult smoking is projected to decrease. As argued before, if the smoking population relative to the entire population changes, this influences the number of patients with Alzheimer's disease and eye disease such as cataract and AMD. Namely, a smaller proportion of smokers relative to the population will contract smoking-related Alzheimer and eye diseases. On the other hand, the proportion of non-smokers increases in these scenarios,

which may result in more non-smoking related Alzheimer and eye diseases, e.g. due to the growing population and aging in general. The following tables present the number of Alzheimer and eye disease patients and their related health care costs in million euros. To adequately estimate the impact of both scenarios, smoking attributable patients and costs are divided into 'caused by smoking' and 'caused by other factors'.

Table 4.9 Scenario 5% tax increase: Number of Alzheimer patients and health care costs per year (million €)

	2015	2017	2020	2030	2040	2050
Non-smoking Alzheimer patients	46814	49787	54309	70798	81583	85439
Smoking Alzheimer patients	10584	10841	11218	12150	11716	10271
Attributable to smoking	6304	6280	6216	5826	5385	4958
Attributable to other factors	4279	4561	5003	6324	6331	5312
Non-smoking Alzheimer costs	€ 2.013	€ 2.018	€ 2.015	€ 1.954	€ 1.676	€ 1.306
Smoking Alzheimer costs	€ 455	€ 439	€ 416	€ 335	€ 241	€ 157
Attributable to smoking	€ 271	€ 255	€ 231	€ 161	€ 111	€ 76
Attributable to other factors	€ 184	€ 185	€ 186	€ 175	€ 130	€ 81

Table 4.10 Scenario 5% tax increase: eye disease patients and health care costs per year (million €)

	2015	2017	2020	2030	2040	2050
Non-smoking eye disease patients	57576	60958	65950	82357	91847	93225
Smoking eye disease patients	17967	18281	18668	19115	17908	15768
Attributable to smoking	11395	11352	11236	10532	9735	8963
Attributable to other factors	6571	6929	7433	8584	8173	6805
Non-smoking eye disease costs	€ 393	€ 392	€ 388	€ 360	€ 299	€ 226
Smoking eye disease costs	€ 120	€ 115	€ 107	€ 82	€ 57	€ 37
Attributable to smoking	€ 75	€ 70	€ 64	€ 44	€ 31	€ 21
Attributable to other factors	€ 45	€ 45	€ 44	€ 38	€ 27	€ 16

Table 4.11 Scenario 10% tax increase: Number of Alzheimer patients and health care costs per year (million €)

	2015	2017	2020	2030	2040	2050
Non-smoking Alzheimer patients	46814	49787	54309	70799	81596	85506
Smoking Alzheimer patients	10584	10841	11191	11833	10869	8836
Attributable to smoking	6304	6280	6199	5650	4937	4182
Attributable to other factors	4279	4561	4992	6183	5932	4654
Non-smoking Alzheimer costs	€ 2.013	€ 2.018	€ 2.015	€ 1.954	€ 1.676	€ 1.307
Smoking Alzheimer costs	€ 455	€ 439	€ 415	€ 327	€ 223	€ 135
Attributable to smoking	€ 271	€ 255	€ 230	€ 156	€ 101	€ 64
Attributable to other factors	€ 184	€ 185	€ 185	€ 171	€ 122	€ 71

Table 4.12 Scenario 10% tax increase: Number of eye disease patients and health care costs per year (million €)

	2015	2017	2020	2030	2040	2050
Non-smoking eye disease patients	57576	60958	65950	82358	91862	93296
Smoking eye disease patients	17967	18281	18623	18609	16591	13531
Attributable to smoking	11395	11352	11206	10213	8924	7560
Attributable to other factors	6571	6929	7417	8397	7667	5971
Non-smoking eye disease costs	€ 393	€ 392	€ 388	€ 360	€ 299	€ 226
Smoking eye disease costs	€ 120	€ 115	€ 107	€ 80	€ 53	€ 32
Attributable to smoking	€ 75	€ 70	€ 64	€ 43	€ 28	€ 18
Attributable to other factors	€ 45	€ 45	€ 44	€ 37	€ 25	€ 14

4.1.4 Consumer surplus

The total consumer surplus within the population for the scenario with 5% and 10% tax increase is estimated to decline over time. For most domains, the incremental costs and benefits are determined by simply looking at the difference between the costs and benefits in the alternative and the reference scenario. The consumer surplus, however, cannot be estimated in an absolute manner, but only incrementally, that is regarding the difference between two scenarios. While it is difficult to estimate the absolute size of consumer surplus (in the reference scenario a rough estimate was made or in the alternative scenarios), it is possible to estimate the change in consumer surplus as a result of a regulatory policy. Therefore, the incremental analyses give a more complete picture of the effects of regulatory policies than the underlying reference and alternative scenarios combined. An increase in excise duties leads to an increase in price and, through the price elasticity, a decrease in demand. As consumers consume less for a higher price, this leads to a decrease in consumer surplus, equal to the average (before and after) consumption multiplied by the increase in price. Hence, a large part of the increase government incomes from tax are transfers between smokers and the government.

Table 4.13 Scenario 5% tax increase vs. reference scenario: Incremental effects on consumer surplus per year in million Euros

	2015	2017	2020	2030	2040	2050
Consumer surplus	0.0	-80.3	-314.0	-1009.3	-1618.1	-2200.8

Table 4.14 Scenario 5% tax increase vs. reference scenario: Incremental effects on consumer surplus per year in million Euros

	2015	2017	2020	2030	2040	2050
Consumer surplus	0.0	-337.4	-888.3	-3223.6	-6866.0	-13009.0

4.1.5 Quality adjusted life years

Estimates of the total number of QALYs and their monetary values for the policy scenario with 5% and 10% annual tax increase can be found in table 4.15 and 4.16.

Table 4.15 Scenario 5% tax increase: Total QALYs and their monetary value per year in Billion Euros

	2015	2017	2020	2030	2040	2050
Number QALYs	13910896	13971734	14045411	14155843	14102804	13998333
Value €50,000	696	658	606	454	337	249
Value €100,000	1391	1317	1212	909	674	497

Table 4.16 Scenario 10% tax increase: Total QALYs and their monetary value per year in Billion Euros

	2015	2017	2020	2030	2040	2050
Number QALYs	13910896	13971734	14045413	14156166	14104890	14004865
Value €50,000	696	658	606	454	337	249
Value €100,000	1391	1317	1212	909	674	498

4.1.6 Productivity

Estimates of the total productivity transfers for the policy scenario with 5% and 10% annual tax increase can be found in table 4.17 and 4.18.

When the prevalence of smokers in a population decreases, direct absenteeism and presenteeism also decrease as less workdays are lost and less smoking breaks are used, leading to more productivity and less waste. The decline in the smoking prevalence results in an increase in (old age-) pensions and social security as the population lives longer. The productivity transfers fluctuates more in future years as it is based on the total labour force in the entire population which is dependent on births, mortality and migration over time. The estimates of the indirect method are the difference in work loss days between the policy scenario and the reference scenario. As the policies are introduced in 2017, there is no difference in absenteeism or presenteeism between the policy and the reference scenario in the year 2015 or 2017 (see table 4.17 and 4.18).

Table 4.17 Scenario 5% tax increase: Production losses per year in million euros

	2015	2017	2020	2030	2040	2050
Direct route						
Absenteeism and presenteeism	7515	7057	6392	4458	3066	2101
Productivity transfers	186484	176677	162451	120265	88607	66148
(Old age-) pensions	41208	41120	40230	35571	28333	20058
Indirect route						
Absenteeism and presenteeism	5598	5272	4823	3475	2646	1943
Total production losses	240805	230126	213896	163769	122652	90249

Table 4.18 Scenario 10% tax increase: Production losses per year in million euros

	2015	2017	2020	2030	2040	2050
Direct route						
Absenteeism and presenteeism	7515	7057	6375	4323	2811	1772
Productivity transfers	186484	176677	162451	120266	88613	66165
(Old age-) pensions	41208	41120	40230	35572	28338	20072
Indirect route						
Absenteeism and presenteeism	5598	5272	4823	3479	2659	1971
Total production losses	240805	230126	213879	163640	122421	89979

4.1.7 Government

In previous years, excise tax on tobacco has been increased regularly and even with a declining prevalence of smokers, the increase in total revenues based on excise tax has continued. This can be explained by the price elasticity of tobacco, which is -0.4. This means that for each 10% increase in retail prices, consumption is reduced by about 4%. Increasing excise tax will therefore lead to increased revenues for the government [92].

Within the annual 5% and 10% tax increase scenario, the government income based on excise tax is based on the projections of the proportional decline in prevalence smokers in future years. In the 5% tax increase scenario, prices and taxes for tobacco will increase over the years. On the one hand, due to a decline in smoking prevalence in the projected years, there will be fewer smokers that pay the excise tax; on the other hand, however, the persistent smokers will pay relatively more excise taxes (see appendix G) and therefore, in total, government income will increase in future years from €3,737 million in 2015 to €5,488 million by 2050 in the 5% tax increase scenario, and to €24,762 million by 2050 in the 10% tax increase scenario (see Table 4.19). Actual government income will be lower, as border effects and smuggling will lead to a loss of income.

Table 4.19 Scenario 5% tax increase: Future government income due to excise tax and VAT on tobacco products per year in million Euros

	2015	2017	2020	2030	2040	2050
Excise tax	2632	2595	2721	3091	3463	3865
Total incl. correction factor	3737	3685	3864	4390	4918	5488

Table 4.20 Scenario 10% tax increase: Future government income due to excise tax and VAT on tobacco products per year in million Euros

	2015	2017	2020	2030	2040	2050
Excise tax	2632	2990	3596	6324	10666	17438
Total incl. correction factor	3737	4246	5106	8981	15146	24762

4.1.8 Others in society

Fire damages

The effects of the policy scenarios via smoking prevalence on total fire damages insurance claims can be found in table 4.21 and 4.22.

Table 4.21 Scenario 5% tax increase: Total costs indoor fires due to smoking per year in million euros

	2015	2017	2020	2030	2040	2050
Total costs	60	57	51	36	25	17

Table 4.22 Scenario 10% tax increase: Total costs indoor fires due to smoking per year in million euros

	2015	2017	2020	2030	2040	2050
Total costs	60	57	51	35	23	14

Passive smoking & smoking during pregnancy

Due to the lack of recent, reliable and conclusive data we were unable to include the effect of the increase of excise tax on passive smoking and smoking during pregnancy. However one may assume that when the prevalence of smoking decreases, these secondary effects will also decrease.

Environment

The effects of the policy scenarios via smoking prevalence on environmental costs can be found in table 4.23 and 4.24.

Table 4.23 Scenario 5% tax increase: Total costs environment per year in million euros

	2015	2017	2020	2030	2040	2050
Total costs	63	59	54	37	26	18

Table 4.24 Scenario 10% tax increase: Total costs environment per year in million euros

	2015	2017	2020	2030	2040	2050
Total costs	63	59	53	36	24	15

4.1.9 Intervention costs

Although in theory tax increases can be implemented by legislation alone, some administrative costs and possible costs of law enforcement to keep smuggling to a minimum have to be made to successfully implement them.

4.1.10 Net present value

An overview of costs and benefits to society is presented in table 4.25 and table 4.26 for an annual 5% tax and 10% tax increase respectively compared with the reference scenario. All costs are presented in million Euros, indexed to 2015 and discounted with 3%.

Both costs of non-smoking related Alzheimer and eye diseases (cataract and AMD) are part of health care costs, therefore the tables below presents solely smoking related Alzheimer costs and smoking related eye disease costs (costs of cataract and AMD).

Table 4.25 Net present value: Total reference scenario costs and increments of Scenario 5% tax increase vs. reference scenario per year in million Euros

		2030		2040		2050	
		Total	Incr.	Total	Incr.	Total	Incr.
Consumers	Value of total QALYs (€50.000)	454,305	10.5	336,779	51.1	248,739	121.6
	Value of consumer surplus*	*	-1009	*	-1618	*	-2201
Producers	Producer surplus	P.m.	P.m.	P.m.	P.m.	P.m.	P.m.
Employers	Absenteeism and presenteeism	4,458	-132.8	3,066	-256.4	2,101	-344.6
	Absenteeism due to chronic diseases	3,475	3.5	2,646	13.2	1,943	29.6
Others in society	Fire damage costs	36	-1.1	25	-2.1	17	-2.8
	Environmental costs	37	-1.1	26	-2.1	18	-2.9
Health care	Smoking related health care costs	6,884	-2.0	5,319	-8.2	3,862	-17.0
	Other diseases health care costs	68,347	0.8	53,118	6.6	39,621	21.1
	Smoking related Alzheimer costs	161	-4.8	111	-9.3	76	-12.4
	Smoking related eye disease costs	44	-1.3	31	-2.6	21	-3.4
Public Authority	Intervention costs	0	0,0	0	0.0	0	0,0
	Enforcement costs	P.m.	P.m.	P.m.	P.m.	P.m.	P.m.
Taxes and duties	Government income	4390	2106.5	4918	3265.5	5488	4272.0
	(Old-age-) pensions transfers	35,571	0.5	28,333	4.9	20,058	14.9
	Productivity transfers	120,265	1.3	88,607	6.7	66,148	17.3

* Only estimated as incremental effect

Table 4.26 Net present value: Total reference scenario costs and increments of Scenario 10% tax increase vs. reference scenario per year in million Euros

		2030		2040		2050	
		Total	Incr.	Total	Incr.	Total	Incr.
Consumers	Value of total QALYs (€50.000)	454,315	20.9	336,829	100.9	248,855	237.6
	Value of consumer surplus*	*	-3224	*	-6866	*	-13009
Producers	Producer surplus	P.m.	P.m.	P.m.	P.m.	P.m.	P.m.

Employers	Absenteeism and presenteeism	4,323	-267.8	2,811	-511.7	1,772	-673.5
	Absenteeism due to chronic diseases	3,479	6.9	2,659	26.1	1,971	57.7
Others in society	Fire damage costs	35	-2.1	23	-4.1	14	-5.4
	Environmental costs	36	-2.2	24	-4.3	15	-5.6
Health care	Smoking related health care costs	6,883	-3.9	5,311	-16.1	3,846	-33.1
	Other diseases health care costs	68,348	1.7	53,124	13.0	39,641	41.3
	Smoking related Alzheimer costs	156	-9.7	101	-18.5	64	-24.3
	Smoking related eye disease costs	43	-2.7	28	-5.1	18	-6.7
Public Authority	Intervention costs	0	0.0	0	0.0	0	0.0
	Enforcement costs	P.m.	P.m.	P.m.	P.m.	P.m.	P.m.
Taxes and duties	Government income	8,981	6697.6	15,146	13.493.8	24,762	23.545.7
	(Old-age-) pensions transfers	35,572	1.0	28,338	9.6	20,072	29.2
	Productivity transfers	120,266	2.5	88,613	13.3	66,165	33.9

* Only estimated as incremental effect

Table 4.27 Overview of social costs and benefits: Scenario 5% tax increase vs. Reference scenario per year in million Euros

		2015	2017	2020	2030	2040	2050
Consumers	Value of gained total QALYs (€50.000)	0.0	0.0	0.1	10.5	51.1	121.6
	Value of consumer surplus	0.0	-80.3	-314.0	-1009.3	-1618.1	-2200.8
Producers	Producer surplus	P.m.	P.m.	P.m.	P.m.	P.m.	P.m.
Employers	Savings absenteeism and presenteeism	0.0	0.0	16.6	132.8	256.4	344.6
	Savings absenteeism due to chronic diseases	0.0	0.0	0.0	-3.5	-13.2	-29.6
Others in society	Savings fire damage	0.0	0.0	0.1	1.1	2.1	2.8
	Savings environment	0.0	0.0	0.1	1.1	2.1	2.9
Health care	Savings smoking related health care costs	0.0	0.0	0.0	2.0	8.2	17.0
	Savings other diseases health care costs	0.0	0.0	0.0	-0.8	-6.6	-21.1
	Savings smoking related Alzheimer costs	0.0	0.0	0.6	4.8	9.3	12.4
	Savings smoking related eye disease costs	0.0	0.0	0.2	1.3	2.6	3.4
Public Authority	Intervention costs	0.0	0.0	0.0	0.0	0.0	0.0
	Enforcement costs	P.m.	P.m.	P.m.	P.m.	P.m.	P.m.
Taxes and duties	Gained government income	0.0	175.5	676.8	2106.5	3265.5	4272.0
	Savings (old-age-) pensions	0.0	0.0	0.0	-0.5	-4.9	-14.9
	Gained productivity transfers	0.0	0.0	0.0	1.3	6.7	17.3
Total		0.0	95.2	380.5	1247.2	1961.1	2527.7

**Negative values (savings) represent extra costs compared to the reference scenario*

Table 4.28 Overview of social costs and benefits: Scenario 10% tax increase vs. Reference scenario per year in million Euros

		2015	2017	2020	2030	2040	2050
Consumers	Value of gained total QALYs (€50.000)	0.0	0.0	0.2	20.9	100.9	237.6

	Value of consumer surplus	0.0	-337.4	-888.3	-3223.6	-6866.0	-13009.0
Producers	Producer surplus	P.m.	P.m.	P.m.	P.m.	P.m.	P.m.
Employers	Savings absenteeism and presenteeism	0.0	0.0	33.5	267.8	511.7	673.5
	Savings absenteeism due to chronic diseases	0.0	0.0	-0.1	-6.9	-26.1	-57.7
Others in society	Savings fire damage	0.0	0.0	0.3	2.1	4.1	5.4
	Savings environment	0.0	0.0	0.3	2.2	4.3	5.6
Health care	Savings smoking related health care costs	0.0	0.0	0.0	3.9	16.1	33.1
	Savings other diseases health care costs	0.0	0.0	0.0	-1.7	-13.0	-41.3
	Savings smoking related Alzheimer costs	0.0	0.0	1.2	9.7	18.5	24.3
	Savings smoking related eye disease costs	0.0	0.0	0.3	2.7	5.1	6.7
Public Authority	Intervention costs	0.0	0.0	0.0	0.0	0.0	0.0
	Enforcement costs	P.m.	P.m.	P.m.	P.m.	P.m.	P.m.
Taxes and duties	Gained government income	0.0	737.0	1918.9	6697.6	13493.8	23545.7
	Savings (old-age-) pensions	0.0	0.0	0.0	-1.0	-9.6	-29.2
	Gained productivity transfers	0.0	0.0	0.0	2.5	13.3	33.9
Total		0.0	399.6	1066.4	3776.3	7253.0	11428.7

**Negative values (savings) represent extra costs compared to the reference scenario*

4.1.11 Cumulative net present value

The cumulative costs and benefits for the 5% and 10% excise tax increase per year are provided in table 4.29 and 4.30.

Table 4.29 Cumulative social costs and benefits: Scenario 5% tax increase vs. Reference scenario - million €

		2020	2030	2040	2050
Consumers	Value of total QALYs (€50.000)	0	39	340	1218
	Value of consumer surplus	-791	-7858	-21337	-40736
Producers	Producer surplus	p.m.	p.m.	p.m.	p.m.
Employers	Absenteeism and presenteeism	29	795	2821	5908
	Absenteeism due to chronic diseases	0	-14	-97	-315
Others in society	Fire damage costs	0	6	23	47
	Environmental costs	0	7	24	49
Healthcare	Smoking related health care costs	0	8	59	187
	Other diseases health care costs	0	-3	-36	-175
	Smoking related Alzheimer costs	1	29	102	213
	Smoking related eye disease costs	0	8	28	59
Public Authority (Government)	Intervention costs	0	0	0	0
	Enforcement costs	p.m.	p.m.	p.m.	p.m.
Taxes and duties	Government income	2648	19652	49582	90504
	(Old-age-) pensions transfers	0	-2	-26	-126
	Productivity transfers	0	5	43	165
Total		1889	12,672	31,524	56,999

**Negative values (savings) represent extra costs compared to the reference scenario*

Table 4.30 Cumulative social costs and benefits: Scenario 10% tax increase vs. Reference scenario - million €

		2020	2030	2040	2050
Consumers	Value of total QALYs (€50.000)	0	79	673	2397
	Value of consumer surplus	-2605	-23599	-74375	-174131
Producers	Producer surplus	p.m.	p.m.	p.m.	p.m.
Employers	Absenteeism and presenteeism	59	1604	5668	11,760
	Absenteeism due to chronic diseases	0	-28	-193	-619
Others in society	Fire damage costs	0	13	45	94
	Environmental costs	0	13	47	98
Healthcare	Smoking related health care costs	0	15	116	368
	Other diseases health care costs	0	-6	-72	-345
	Smoking related Alzheimer costs	2	58	204	424
	Smoking related eye disease costs	1	16	57	117
Public Authority (Government)	Intervention costs	0	0	0	0
	Enforcement costs	p.m.	p.m.	p.m.	p.m.
Taxes and duties	Government income	5653	49,916	152,090	339,159
	(Old-age-) pensions transfers	0	-3	-51	-248
	Productivity transfers	0	9	86	325
Total		3,111	28,088	84,296	179,402

**Negative values (savings) represent extra costs compared to the reference scenario*

4.1.12 Sensitivity analyses

The results of the probabilistic sensitivity analysis are provided below. Next to probabilistic sensitivity analysis, one-way sensitivity analyses were performed by changing fixed parameters. The results of the one-way sensitivity analyses (i.e. different WTP values for QALYs and the in-/exclusion of the consumer surplus) can be found in Chapter 7.5.

Probabilistic sensitivity analyses

Table 4.31 Confidence intervals (CI) for the incremental costs of scenario 5% tax increase vs. Reference scenario based on PSA per year in million Euros

		2015	2017	2020	2030	2040	2050
Consumers	Base case	0.0	-80.3	-313.9	-998.8	-1567.0	-2079.2
95%CI	Lower bound	0.0	-80.4	-314.5	-1002.2	-1574.5	-2090.2
	Upper bound	0.0	-80.2	-313.2	-995.8	-1561.1	-2068.7
Producers	Base case (Fixed)	P.m.	P.m.	P.m.	P.m.	P.m.	P.m.
Employers	Base case	0.0	0.0	16.6	129.3	243.2	315.0
95%CI	Lower bound	0.0	0.0	16.6	128.8	241.2	310.2
	Upper bound	0.0	0.0	16.6	129.6	244.4	317.8
Others in society	Base case	0.0	0.0	0.3	2.2	4.2	5.6
95%CI	Lower bound	0.0	0.0	0.3	2.2	4.2	5.6
	Upper bound	0.0	0.0	0.3	2.2	4.2	5.7
Health care	Base case	0.0	0.0	0.8	7.3	13.4	11.8
95%CI	Lower bound	0.0	0.0	0.8	7.2	12.9	10.1
	Upper bound	0.0	0.0	0.8	7.5	15.1	16.2

Public authority	Base case (Fixed)	0.0	0.0	0.0	0.0	0.0	0.0
Taxes and duties	Base case	0.0	175.5	676.8	2107.3	3267.3	4274.4
95%CI	Lower bound	0.0	175.4	676.3	2104.1	3261.8	4268.8
	Upper bound	0.0	175.5	677.3	2111.5	3275.2	4284.5
Total	Base case	0.0	95.2	380.5	1247.2	1961.1	2527.7
95%CI	Lower bound	0.0	95.1	380.3	1246.3	1959.5	2525.6
	Upper bound	0.0	95.2	380.8	1248.6	1964.3	2532.3

Table 4.32 Confidence intervals (CI) for the incremental costs of scenario 10% tax increase vs. Reference scenario based on PSA (in millions)

		2015	2017	2020	2030	2040	2050
Consumers	Base case	0.0	-337.4	-888.1	-3202.7	-6765.1	-12771.3
95%CI	Lower bound	0.0	-337.9	-889.8	-3213.5	-6792.6	-12821.6
	Upper bound	0.0	-336.8	-886.2	-3193.4	-6743.3	-12731.1
Producers	Base case (Fixed)	P.m.	P.m.	P.m.	P.m.	P.m.	P.m.
Employers	Base case	0.0	0.0	33.4	260.9	485.6	615.7
95%CI	Lower bound	0.0	0.0	33.3	259.9	481.6	606.4
	Upper bound	0.0	0.0	33.4	261.5	488.1	621.1
Others in society	Base case	0.0	0.0	0.5	4.4	8.4	11.0
95%CI	Lower bound	0.0	0.0	0.5	4.4	8.4	11.0
	Upper bound	0.0	0.0	0.5	4.4	8.4	11.1
Health care	Base case	0.0	0.0	1.6	14.6	26.7	22.8
95%CI	Lower bound	0.0	0.0	1.6	14.6	25.8	19.6
	Upper bound	0.0	0.0	1.6	15.2	30.1	31.5
Public authority	Base case (Fixed)	0.0	0.0	0.0	0.0	0.0	0.0
Taxes and duties	Base case	0.0	737.0	1918.9	6699.1	13497.5	23550.4
95%CI	Lower bound	0.0	736.8	1917.6	6688.7	13473.5	23517.9
	Upper bound	0.0	737.2	1920.3	6712.5	13530.2	23605.5
Total	Base case	0.0	399.6	1066.4	3776.3	7253.0	11428.7
95%CI	Lower bound	0.0	399.3	1065.7	3773.4	7244.5	11412.2
	Upper bound	0.0	400.0	1066.9	3780.4	7264.6	11446.9

4.2 Mass Media Campaign

Mass media interventions consist of the dissemination of information through television, radio, print media and billboards, with the intention of encouraging smokers to quit, and of maintaining abstinence in non-smokers. Mass media campaigns (MMC) can be effective in keeping tobacco control on the social and political agenda, in legitimising community action and in triggering other interventions. Campaigns are designed either directly to change individuals' smoking behaviour, or to catalyse other forces of social change, which may then lead to a change in social norms about smoking [109]. The latter type of campaigns are designed to de-normalize smoking, thus counteracting the tobacco industry's message that smoking is desirable and harmless [110]. In order to reach the proposed effects, continued mass media campaigns should have enough exposure, should be regularly updated, and should remain innovative in order to avoid campaign fatigue in the population.

Population exposure to televised national mass media campaigns are measured by advertising rating points: gross rating points (GRPs) and targeted ratings points (TRPs). GRPs are a standard advertising industry measure of campaign reach X frequency. A 100% exposure reach to 10 adverts, or 50% exposure to 20 adverts, results both in an average of 1000 GRPs. For an overall campaign, it is estimated that adverts should reach 75% to 85% of the target audience each quarter of the year. A campaign is expected to run at least 3 to 6 months to achieve awareness of the issue, 6 to 12 months to influence attitudes, and 12 to 18 months to influence behaviour [111, 112]. Nevertheless, some campaigns have influenced behaviour within three months [113, 114]. Examples of Dutch mass media campaigns, that effected behaviour within three months are "Dat Kan Ik Ook!", "Nederland start met Stoppen", and "Stoptober" [115].

Few studies have considered the intensity of campaign investment that can most efficiently achieve population changes. Taken together, these studies suggest that in high-income countries, an average of 1200 GRPs per quarter are needed to reduce smoking prevalence during the introduction of a campaign and a minimum average of 800 GRPs per quarter thereafter [111, 116-120].

4.2.1 Methods

For mass media campaigns, national prevalence data is combined with an estimate based on international literature, and used to estimate baseline values and an uncertainty range for the effects. We followed the methods previously described by Feenstra et al. [121]. In short, relative reductions in population prevalence rates after a tobacco control campaign are used as effect sizes, deflated with a correction factor to calculate the net effect of mass media campaigns corrected for

autonomous trends. Correction leads to an estimated net effect of 1.0-1.4 percentage points based on Dutch data. The relative net effect based on international data was between 0.4 and 0.7 percentage points a year. The 'most probable effect' of a MMC was then assumed to be between 0.5 and 1.0 percentage points reduction of the smoking prevalence. Full details can be found in appendix H. Using results from this study one can determine the maximum effectiveness of MMC (decrease of the relative prevalence of smokers of 6.5% per year) and the minimum effectiveness of MMC (decrease of the relative prevalence of smokers of 1.2% per year).

In the study of Feenstra et al. [121], MMC was shown to be quite effective. Hence, in our study, a scenario was chosen to resemble the minimum impact that a MMC could have (based on the range of the relative net effect), the so-called low impact scenario. In this scenario, the impact of MMC leads to a yearly relative decrease of smoking prevalence of 1.2%.

4.2.2 Smoking prevalence

If the MMC is implemented, adult smoking is projected to decrease from 19.8% from 2015, to 19.6% by 2017, to 19.1% by 2020, to 16.8% by 2030, to 14.6% by 2040 and to 12.5% by 2050 (See Table 4.33 for gender specific smoking prevalence).

Table 4.33 Scenario MMC low impact: Gender specific smoking prevalence projections

	2015	2017	2020	2030	2040	2050
Male smokers	21.9%	21.6%	21.0%	18.5%	16.0%	13.7%
Female smokers	17.8%	17.6%	17.1%	15.1%	13.1%	11.3%
All smokers	19.8%	19.6%	19.1%	16.8%	14.6%	12.5%
Male ex-smokers	28.9%	28.7%	28.5%	27.3%	25.7%	24.1%
Female ex-smokers	29.0%	28.9%	28.7%	27.6%	25.5%	23.0%
All ex-smokers	28.9%	28.8%	28.6%	27.5%	25.6%	23.5%
Male never smokers	49.2%	49.7%	50.5%	54.2%	58.3%	62.2%
Female never smokers	53.2%	53.5%	54.1%	57.2%	61.4%	65.7%
All never smokers	51.2%	51.6%	52.3%	55.7%	59.9%	64.0%

4.2.3 Health care impact

Table 4.34 and 4.35 presents the prevalence of smoking-attributable diseases in the population under the MMC scenario, the health care costs and the smoking-related mortality.

Table 4.34 Scenario MMC low impact: Prevalence* of smoking-related diseases

Chronic diseases	2015	2017	2020	2030	2040	2050
Lung cancer	0.22%	0.22%	0.23%	0.25%	0.23%	0.20%
Stomach cancer	0.04%	0.04%	0.04%	0.04%	0.05%	0.05%
Oesophagus cancer	0.05%	0.05%	0.05%	0.06%	0.06%	0.05%
Larynx cancer	0.05%	0.05%	0.05%	0.05%	0.05%	0.04%
Bladder cancer	0.12%	0.12%	0.13%	0.15%	0.16%	0.16%
Kidney cancer	0.12%	0.12%	0.12%	0.13%	0.14%	0.13%
Pancreas cancer	0.02%	0.02%	0.02%	0.03%	0.03%	0.03%
Oral cavity cancer	0.03%	0.03%	0.03%	0.03%	0.02%	0.02%
Myocardial infarction	4.01%	4.10%	4.23%	4.56%	4.62%	4.46%
Congestive heart failure	0.92%	0.96%	1.02%	1.24%	1.38%	1.42%
Stroke	1.37%	1.44%	1.54%	1.80%	1.90%	1.87%
COPD	2.55%	2.66%	2.83%	3.15%	3.10%	2.88%
Diabetes	5.50%	5.66%	5.87%	6.39%	6.56%	6.53%

* the prevalence refers to the total prevalence, attributable and non-attributable to smoking

Table 4.35 Scenario MMC low impact: Health care costs in absolute numbers per year (million Euros) and the number of smoking-related deaths

	2015	2017	2020	2030	2040	2050
Smoking-related diseases	8347	8230	8013	6881	5307	3841
Other diseases	90501	87578	83150	68349	53128	39649
Smoking related deaths	14509	15928	17404	17568	8735	-1505*

* Negative value because if people would never have smoked, they would have lived longer and would die later. Hence, the number of deaths in 2050 would be higher compared to a situation with smoking.

Other smoking attributable diseases

Table 4.36 presents the prevalence and costs of smoking-attributable Alzheimer in the population under the MMC scenario.

Table 4.36 MMC scenario: Number of Alzheimer patients and smoking-attributable health care costs per year (million €)

	2015	2017	2020	2030	2040	2050
Non-smoking Alzheimer patients	46814	49787	54309	70800	81605	85537
Smoking Alzheimer patients	10584	10828	11149	11683	10670	8706
Attributable to smoking	6304	6272	6173	5566	4833	4115
Attributable to other factors	4279	4556	4976	6117	5837	4591
Non-smoking Alzheimer costs	€ 2.013	€ 2.018	€ 1.901	€ 1.954	€ 1.676	€ 1.307
Smoking Alzheimer costs	€ 455	€ 439	€ 406	€ 322	€ 219	€ 133
Attributable to smoking	€ 271	€ 254	€ 232	€ 154	€ 99	€ 63
Attributable to other factors	€ 184	€ 185	€ 174	€ 169	€ 120	€ 70

Table 4.37 presents the prevalence and costs of smoking-attributable eye disease patients in the population under the MMC scenario.

Table 4.37 MMC scenario: Number of eye disease patients and smoking-attributable health care costs per year (million €)

	2015	2017	2020	2030	2040	2050
Non-smoking eye disease patients	57576	60958	65950	82359	91872	93327
Smoking eye disease patients	17967	18260	18553	18370	16281	13328
Attributable to smoking	11395	11338	11159	10061	8736	7439
Attributable to other factors	6571	6922	7394	8309	7545	5889
Non-smoking eye disease costs	€ 393	€ 392	€ 388	€ 360	€ 299	€ 226
Smoking eye disease costs	€ 120	€ 115	€ 107	€ 79	€ 52	€ 32
Attributable to smoking	€ 75	€ 70	€ 63	€ 42	€ 27	€ 17
Attributable to other factors	€ 45	€ 44	€ 43	€ 36	€ 25	€ 14

4.2.4 Consumer surplus

The total consumer surplus within the population for the MMC scenario is estimated to decline over time. The scenario has a decreasing effect on the smoking prevalence and with this, consumer surplus decreases in future years [22]. Based on the estimate of the consumer surplus in the reference scenario and the number of smokers per year, the incremental effect on the consumer surplus was estimated for the MMC scenario.

Table 4.38 Scenario low MMC vs. reference scenario: Incremental effects on consumer surplus per year in million Euros

	2015	2017	2020	2030	2040	2050
Consumer surplus	0.0	-4.9	-34.8	-190.7	-327.9	-402.9

4.2.5 Quality adjusted life years

Estimates of the total number of QALYs and their monetary values for the policy scenarios are provided below for MMC scenario.

Table 4.39 Scenario MMC: Total QALYs and their monetary value per year in Billion Euros

	2015	2017	2020	2030	2040	2050
Number QALYs	13910896	13971734	14045423	14156448	14105941	14007000

[22] Yearly consumer surplus per smoker: 250 cigarette packages per year * €10.08 = €2,520.

Value €50,000	696	658	606	454	337	249
Value €100,000	1391	1317	1212	909	674	498

4.2.6 Productivity

Estimates of the total productivity transfers for the scenario due to MMC can be found in table 4.40. As the policies are being introduced in 2017, there is no difference in absenteeism or presenteeism between the policy and the reference scenario in the year 2015 or 2017.

Table 4.40 Scenario MMC: Production losses per year in million euros

	2015	2017	2020	2030	2040	2050
Direct methods						
Absenteeism and presenteeism	7515	7048	6348	4259	2752	1744
Productivity transfers	186484	176677	162451	120268	88617	66170
(Old age-) pensions	41208	41120	40230	35572	28341	20078
Indirect method						
Absenteeism and presenteeism	5598	5272	4823	3481	2665	1979
Total production losses	240805	230117	213852	163580	122374	89971

4.2.7 Government

Within the mass media scenario, the government income based on excise tax is based on the projections of the proportional decline in smoking prevalence in future years. The assumption is made that prices and taxes for tobacco remain constant over the years. Due to the projected decline in smoking prevalence within the mass media scenarios, the government incomes are decreasing (see table 4.41).

Table 4.41 Scenario MMC: Future government income due to excise tax and VAT on tobacco products per year in million Euros

	2015	2017	2020	2030	2040	2050
Excise tax	2632	2468	2223	1492	964	611
Total incl. correction factor	3737	3505	3157	2118	1368	867

4.2.8 Others in society

Fire damages

The effects of the MMC scenario via smoking prevalence on total fire damages insurance claims are described below.

Table 4.42 Scenario low MMC: Total costs indoor fires due to smoking per year in million euros

	2015	2017	2020	2030	2040	2050
Total costs	60	56	51	34	22	14

Passive smoking & smoking during pregnancy

Effects on passive smoking & smoking during pregnancy are not estimated nor monetarised in this SCBA report.

Environment

The effects via smoking prevalence on environmental costs can be found in Table 4.43.

MMC scenario

Table 4.43 Scenario low MMC: Total costs environment per year in million euros

	2015	2017	2020	2030	2040	2050
Total costs	63	59	53	36	23	15

4.2.9 Intervention costs

Based on a Dutch campaigns, as mentioned earlier, in 2008, 4150 GRPs were reached at a cost of €5.32 million (€4.75 million price index year 2008), with an average of €1,282 (€1,145 price index year 2008) per GRP [115]. An effective continuous campaign, would cost 4,800 * €1,282= €6.15 million in the introduction year and 3,600 * €1,282 = €4.62 million in prospective years. Continuous anti-tobacco campaigns will be renewed every 3 years in order to avoid campaign-tiredness of the population. Therefore, every 3 years, an introduction year with 4800 GRPs will be followed by 2 follow-up years (3600 GRPs).

4.2.10 Net present value

An overview of costs and benefits to society is presented in table 4.44 and table 4.45 for the MMC scenario compared with the reference scenario. All costs are presented in million Euros, indexed to 2015 price level, and discounted at 3%.

MMC scenario

Table 4.44 Net present value: Total reference scenario costs and increments of Scenario MMC vs. reference scenario per year in million euros

		2030		2040		2050	
		Total	Incr.	Total	Incr.	Total	Incr.
Consumers*	Value of total QALYs (€50.000)	454324	29.9	336854	126.0	248893	275.6
	Value of consumer surplus	*	-190.7	*	-327.9	*	-402.9
Producers	Producer surplus	P.m.	P.m.	P.m.	P.m.	P.m.	P.m.
Employers	Absenteeism and presenteeism	4259	-332.1	2752	-571.0	1744	-701.7
	Absenteeism due to chronic diseases	3481	9.7	2665	31.8	1979	66.0
Others in society	Fire damage costs	34	-2.7	22	-4.6	14	-5.6
	Environmental costs	36	-2.8	23	-4.8	15	-5.9
Health care	Smoking related health care costs	6881	-5.5	5307	-19.7	3841	-37.7
	Other diseases health care costs	68349	2.5	53128	16.9	39649	49.7
	Smoking related Alzheimer costs	154	-12.0	99	-20.6	63	-25.3
	Smoking related eye disease costs	42	-3.3	27	-5.7	17	-7.0
Public Authority	Intervention costs	4	3.9	3	2.9	2	2.2
	Enforcement costs	P.m.	P.m.	P.m.	P.m.	P.m.	P.m.
Taxes and duties	Government income	2118	-165.1	1368	-284.0	867	-349.0
	(Old-age-) pensions transfers	35572	1.6	28341	12.6	20078	35.1
	Productivity transfers	120268	3.7	88617	16.8	66170	39.6

* Only estimated as incremental effect

Table 4.45 Overview of social costs and benefits: Scenario MMC vs. Reference scenario per year in million euros

		2015	**2017**	**2020**	**2030**	**2040**	**2050**
Consumers	Value of gained total QALYs (€50.000)	0.0	0.0	0.6	29.9	126.0	275.6
	Value of consumer surplus	0.0	-4.9	-34.8	-190.7	-327.9	-402.9
Producers	Producer surplus	P.m.	P.m.	P.m.	P.m.	P.m.	P.m.
Employers	Savings absenteeism and presenteeism	0.0	8.6	60.5	332.1	571.0	701.7
	Savings absenteeism due to chronic diseases	0.0	0.0	-0.3	-9.7	-31.8	-66.0
Others in society	Savings fire damage	0.0	0.1	0.5	2.7	4.6	5.6
	Savings environment	0.0	0.1	0.5	2.8	4.8	5.9
Health care	Savings smoking related health care costs	0.0	0.0	0.1	5.5	19.7	37.7
	Savings other diseases health care costs	0.0	0.0	0.0	-2.5	-16.9	-49.7
	Savings smoking related Alzheimer costs	0.0	0.3	-0.5	12.0	20.6	25.3
	Savings smoking related eye disease costs	0.0	0.1	0.6	3.3	5.7	7.0

Public Authority	Intervention costs	0.0	-5.8	-5.3	-3.9	-2.9	-2.2
	Enforcement costs	P.m.	P.m.	P.m.	P.m.	P.m.	P.m.
Taxes and duties	Gained government income	0.0	-4.3	-30.1	-165.1	-284.0	-349.0
	Savings (old-age-) pensions	0.0	0.0	0.0	-1.6	-12.6	-35.1
	Gained productivity transfers	0.0	0.0	0.1	3.7	16.8	39.6
Total		0.0	-5.9	-8.0	18.4	93.0	193.6

* Positive values imply a benefit to society compared to the reference scenario and a negative value implies a cost to society compared to the reference scenario.

4.2.11 Cumulative net present value

The cumulative costs and benefits for the MMC low impact scenario are provided in table 4.46.

Table 4.46 Cumulative social costs and benefits: MMC low impact vs. Reference scenario - million €

		2020	2030	2040	2050
Consumers	Value of total QALYs (€50.000)	1	121	893	2945
	Value of consumer surplus	-76	-1256	-3960	-7708
Producers	Producer surplus	p.m.	p.m.	p.m.	p.m.
Employers	Absenteeism and presenteeism	132	2187	6896	13,423
	Absenteeism due to chronic diseases	0	-42	-251	-749
Others in society	Fire damage costs	1	18	55	108
	Environmental costs	1	18	58	112
Healthcare	Smoking related health care costs	0	23	151	446
	Other diseases health care costs	0	-9	-98	-435
	Smoking related Alzheimer costs	5	79	249	484
	Smoking related eye disease costs	1	22	69	134
Public Authority (Government)	Intervention costs	19	46	59	62
	Enforcement costs	p.m.	p.m.	p.m.	p.m.
Taxes and duties	Government income	-65	-1087	-3430	-6676
	(Old-age-) pensions transfers	0	-5	-71	-314
	Productivity transfers	0	14	114	402
Total		18	129	734	2234

**Negative values (savings) represent extra costs compared to the reference scenario*

4.2.12 Sensitivity analyses

Next to probabilistic sensitivity analysis, one-way sensitivity analyses were performed by changing fixed parameters. Below the results of the probabilistic sensitivity analysis are provided and the results of the one-way sensitivity analyses regarding the effectiveness estimate of MMC. The effect size of the MMC is an important determinant in the benefits and costs of the MMC scenario. Hence, in addition to the low impact scenarios, two other possible scenarios are estimated with different effect sizes for mass media campaigns, the medium effect size and maximum effect size scenarios respectively. In the medium MMC scenario, the effect size is estimated to lead to a decrease of smoking prevalence with 3.55%. In the maximum MMC scenario the effect size is estimated to lead to a relative decrease of smoking prevalence with 6.5% per year (see appendix H).

One-sensitivity analyses regarding the value of the QALY and the in-/exclusion of the consumer surplus can be found in Chapter 7.5.

MMC medium impact scenario

Table 4.47 Overview of social costs and benefits: Scenario medium MMC vs. Reference scenario per year in million euros

		2015	2017	2020	2030	2040	2050
Consumers	Value of gained total QALYs (€50.000)	0.0	0.0	2.4	103.1	395.8	773.8
	Value of consumer surplus	0.0	-19.1	-134.9	-695.0	-1031.4	-1048.4
Producers	Producer surplus	P.m.	P.m.	P.m.	P.m.	P.m.	P.m.
Employers	Savings absenteeism and presenteeism	0.0	33.3	235.0	1210.4	1796.2	1825.9
	Savings absenteeism due to chronic diseases	0.0	0.0	-1.0	-33.2	-98.3	-181.3
Others in society	Savings fire damage	0.0	0.3	1.9	9.7	14.4	14.6
	Savings environment	0.0	0.3	2.0	10.1	15.0	15.3
Health care	Savings smoking related health care costs	0.0	0.0	0.5	18.9	60.4	101.5
	Savings other diseases health care costs	0.0	0.0	-0.1	-8.6	-54.3	-144.5
	Savings smoking related Alzheimer costs	0.0	1.2	8.5	43.7	64.8	65.9
	Savings smoking related eye disease costs	0.0	0.3	2.3	12.1	17.9	18.2
Public Authority	Intervention costs	0.0	-5.8	-5.3	-3.9	-2.9	-2.2
	Enforcement costs	P.m.	P.m.	P.m.	P.m.	P.m.	P.m.
Taxes and duties	Gained government income	0.0	-16.6	-116.9	-602.0	-893.3	-908.0
	Savings (old-age-) pensions	0.0	0.0	-0.1	-11.6	-64.1	-115.3
	Gained productivity transfers	0.0	0.0	0.3	12.7	53.4	113.3
Total		**0.0**	**-6.1**	**-5.6**	**66.5**	**273.8**	**528.8**

**Negative values (savings) represent extra costs compared to the reference scenario*

MMC maximum impact scenario

Table 4.48 Overview of social costs and benefits: Scenario maximum MMC vs. Reference scenario per year in million euros

		2015	2017	2020	2030	2040	2050
Consumers	Value of gained total QALYs (€50.000)	0.0	0.0	5.6	203.5	598.0	874.7
	Value of consumer surplus	0.0	-47.6	-341.7	-1539.0	-1594.5	-1239.3
Producers	Producer surplus	P.m.	P.m.	P.m.	P.m.	P.m.	P.m.
Employers	Savings absenteeism and presenteeism	0.0	82.8	595.2	2680.3	2776.9	2158.4
	Savings absenteeism due to chronic diseases	0.0	0.0	-2.4	-64.8	-145.1	-203.0
Others in society	Savings fire damage	0.0	0.7	4.8	21.5	22.3	17.3
	Savings environment	0.0	0.7	5.0	22.4	23.3	18.1

Health care	Savings smoking related health care costs	0.0	0.0	1.2	36.0	84.1	102.9
	Savings other diseases health care costs	0.0	0.0	-0.3	-17.4	-84.0	-159.0
	Savings smoking related Alzheimer costs	0.0	3.0	21.5	96.7	100.2	77.9
	Savings smoking related eye disease costs	0.0	0.8	5.9	26.7	27.7	21.5
Public Authority	Intervention costs	0.0	-5.8	-5.3	-3.9	-2.9	-2.2
	Enforcement costs	P.m.	P.m.	P.m.	P.m.	P.m.	P.m.
Taxes and duties	Gained government income	0.0	-41.2	-296.0	-1333.0	-1381.0	-1073.4
	Savings (old-age-) pensions	0.0	0.0	-0.1	-11.6	-64.1	-115.3
	Gained productivity transfers	0.0	0.0	0.6	25.6	84.5	135.0
Total		**0.0**	**-6.6**	**-6.1**	**142.9**	**445.2**	**613.5**

**Negative values (savings) represent extra costs compared to the reference scenario*

Probabilistic sensitivity analyses

Table 4.49 Confidence intervals (CI) for the incremental costs of scenario low impact MMC vs. Reference scenario based on PSA per year (in millions)

		2015	2017	2020	2030	2040	2050
Consumers	Base case	0.0	-4.9	-34.1	-160.7	-201.9	-127.4
95%CI	Lower bound	0.0	-4.9	-34.2	-162.3	-208.9	-142.2
	Upper bound	0.0	-4.9	-34.1	-159.1	-194.8	-111.4
Producers	Base case (Fixed)	P.m.	P.m.	P.m.	P.m.	P.m.	P.m.
Employers	Base case	0.0	8.6	60.3	322.4	539.3	635.7
95%CI	Lower bound	0.0	8.6	60.2	321.1	534.3	624.9
	Upper bound	0.0	8.6	60.3	323.2	542.2	641.9
Others in society	Base case	0.0	0.1	1.0	5.4	9.4	11.5
95%CI	Lower bound	0.0	0.1	1.0	5.4	9.3	11.5
	Upper bound	0.0	0.1	1.0	5.4	9.4	11.5
Health care	Base case	0.0	0.4	0.2	18.3	29.1	20.3
95%CI	Lower bound	0.0	0.4	0.2	18.2	27.9	16.2
	Upper bound	0.0	0.4	0.3	19.2	33.5	30.4
Public authority	Base case (Fixed)	0.0	-5.8	-5.3	-3.9	-2.9	-2.2
Taxes and duties	Base case	0.0	-4.3	-30.1	-163.1	-279.8	-344.4
95%CI	Lower bound	0.0	-4.3	-30.1	-163.2	-280.2	-345.6
	Upper bound	0.0	-4.3	-30.1	-162.9	-278.6	-341.6
Total	Base case	0.0	-5.9	-8.0	18.4	93.0	193.6
95%CI	Lower bound	0.0	-5.9	-8.1	17.8	91.1	188.5
	Upper bound	0.0	-5.8	-7.9	19.5	97.2	202.2

**Negative values (savings) represent extra costs compared to the reference scenario*

5. Part II Alternative scenario: Policy packages

Chapter 5 describes the policy packages scenarios. An overview of the structure of chapter 5 can be found in Figure 5.1.

Figure 5.1 Overview Chapter 5: Policy packages

5.1	Policy Packages	
	5.1.1	Methods
	5.1.2	Smoking prevalence
	5.1.3	Health care impact
	5.1.4	Consumer surplus
	5.1.5	Quality adjusted life years
	5.1.6	Productivity
	5.1.7	Government
	5.1.8	Others in society
	5.1.9	Intervention costs
	5.1.10	Net present value
	5.1.11	Cumulative net present value
	5.1.12	Sensitivity analyses

5.1 Policy Packages

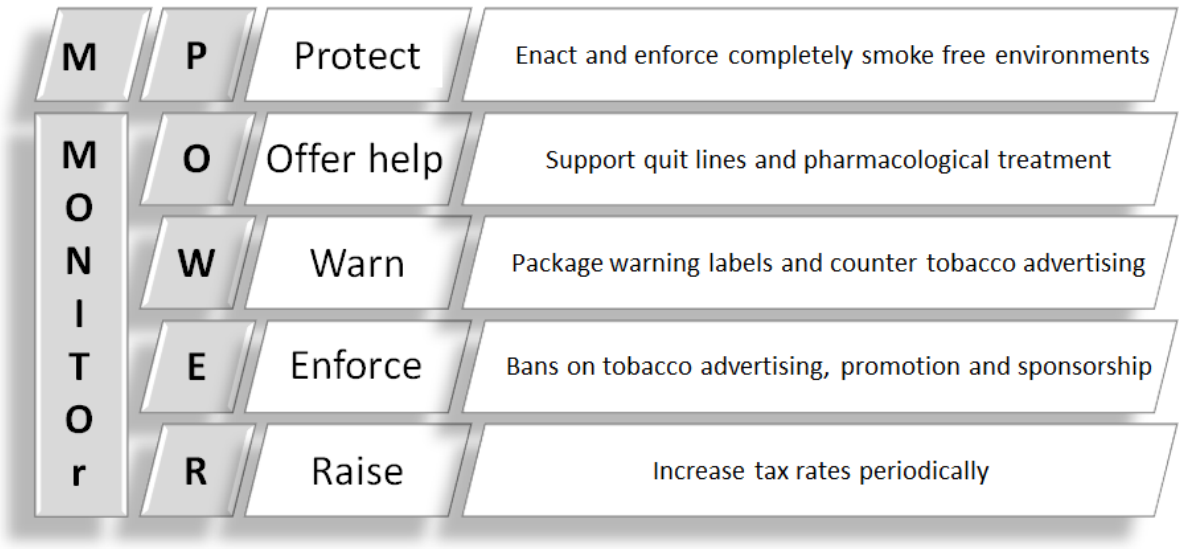
International efforts led by WHO resulted in rapid entry into force of the WHO Framework Convention on Tobacco Control (WHO FCTC) [122], which has 168 signatories (including the Netherlands since 2003) and 180 parties. The WHO FCTC provides the principles and context for policy development, planning of interventions and mobilization of political and financial resources for tobacco control.

Parties to the WHO FCTC have committed themselves to protecting the health of their populations by joining the fight against the tobacco epidemic. To help countries fulfil the promise of the WHO FCTC and turn this global consensus into a global reality, a policy package that builds on the measures of the WHO FCTC that have been proven to reduce smoking prevalence has been recommended in the Netherlands [123].

Figure 5.1 presents a summary of the recommended policy package called MPOWER. The policies are complementary and synergistic. For example, increasing taxation will help tobacco users quit, reduce the number of new tobacco users and protect people from second-hand smoke. Bans on tobacco industry promotion and anti-tobacco advertising will educate people about the health risks of tobacco use, alter public perceptions of smoking and facilitate political decision-making. They will

also support the enforcement of tax legislation, ad bans and smoke-free laws. Rigorous monitoring is necessary to obtain baseline information, target activities, track progress and evaluate the results of interventions.

Figure 5.1 Overview of the MPOWER package (based on http://www.who.int/tobacco/mpower/en/)



5.1.1 Methods

In order to examine the potential effect of a tobacco control policy package on smoking prevalence, the most recent version of the Netherlands SimSmoke was used.

Policy effect sizes are in terms of percentage reductions applied to smoking prevalence in the year when a policy is implemented and, unless specified otherwise, applied to initiation and cessation rates in future years. The input policy parameters are based on a combination of reviews, expert panel and model validation [24]. As a high-income country, the effects for the Netherlands were determined primarily from studies performed in comparable high-income countries.

Content policy package

The SimSmoke model estimates the smoking prevalence over time. The model estimates these outcomes from the 'tracking period', from 1996 to 2014 and projects future smoking prevalence for 2015 to 2050. Following the work of Nagelhout et al. [24], the SimSmoke model was calibrated towards the Dutch setting based on comparing actual Dutch smoking prevalence to the predicted smoking prevalence rates from 1996 to 2013, and adjusting the model when necessary.
Policies and potential effects sizes are summarized in table 5.1. Policy effect sizes are in terms of relative percentage reductions and unless synergies are specified, the effect of a second policy simultaneously implemented is reduced by 1 - the effect of the first policy. More detail regarding the

SimSmoke model and methods to deal with the synergy between policies can be found in Nagelhout et al. [24].

Table 5.1 Policies, description and effect sizes of the SimSmoke Model

Policy	Description	Potential Percentage Effect*
Tax Policy	Cigarette price index, taxes measure in absolute terms	Through price elasticity: -0.3 ages 15-17 -0.3 age 18-24 -0.2 ages 25-34 -0.1 ages 35-65 and above -0.3 ages 65 and above
Clean Air Policies		
Ban in all workplaces	Ban in all areas	6% effect
Ban in indoor offices only	Ban in indoor offices	4% effect
Ban in health facilities, universities, government facilities	Ban in 2 of 3 (health facilities, universities, government facilities)	2% effect
Ban in restaurants	Ban in all indoor restaurants in all areas	2% effect
Ban in pubs and bars	Ban in all indoor pubs and bars in all areas	1% effect
Enforcement level	Government agency is designated to enforce and publicize the laws	Effects reduced by as much as 50% if zero enforcement
Mass Media Campaigns		
Well-funded media/tobacco control campaign	Campaign publicized heavily on TV (at least two months of the year) and at least some other media	3.25% effect (doubled when accompanied by local programs)
Moderately funded media/tobacco control campaign	Campaign publicized sporadically on TV and in at least some other media, and a local program	1.6% effect (doubled when accompanied by local programs)
Low funded media/tobacco control campaign	Campaign publicized only sporadically in newspaper, billboard or some other media.	0.5% effect (doubled when accompanied by local programs)
Advertising Bans		
Ban on direct and indirect marketing	Ban is applied television, radio, print, billboard, in-store displays, sponsorships and free samples	5% reduction in prevalence, 6% reduction in initiation, 3% increase in cessation rates
Ban on advertising	Ban is applied all media television, radio, print, billboard	3% reduction in prevalence, 4% reduction in initiation, 2% increase in cessation rates
Partial ban on advertising	Ban is applied some of television, radio, print, billboard	1% reduction in prevalence and initiation only
Enforcement level	Government agency is designated to enforce the laws	Effects reduced by as much as 50% if zero enforcement
Warning Labels		
Strong health warnings	Labels are large, bold and graphic	4% reduction in prevalence, 4% reduction in initiation, 8% increase in cessation rates
Moderate health warnings	Warnings covers at least ⅓ of both sides of package, not bold or graphic	3% reduction in prevalence, 4% reduction in initiation, 2% increase in cessation rates
Mild health warnings	Warning covers less than ⅓ of package, not bold or graphic	1% reduction in prevalence and initiation only

Cessation Treatment Policy		
Availability of pharmacotherapy NRT	NRT available at general store	
Availability of pharmacotherapy Bupropion	Bupropion available at general store	
Financial coverage of treatments		
Quit line		0.5% reduction in prevalence 5% increase in cessation rates
Health care provider involvement		
Youth Access Restrictions		
Vending machine ban	Ban is applied to the use of vending machines by youth	2% reduction for age <16 1% reduction for ages 16-17
Self-service ban	Ban is applied to the use of self-services by youth	3% reduction for age <16 2% reduction for ages 16-17
Strongly enforced & publicized	Compliance checks are conducted regularly, penalties are heavy, and strong publicity	15% reduction for age < 16 10% reduction for ages 16-17
Well enforced	Compliance checks are conducted sporadically, penalties are potent, and little publicity	8% reduction for age < 16 5% reduction for ages 16-17
Low enforcement	Compliance checks are not conducted, penalties are weak, and no publicity	2% reduction for age < 16 1% reduction for ages 16-17
Community based publicity campaign		10% effect
Retailer Restrictions		
Strong		13% reduction in initiation 13% increase in cessation rates
Moderate		7% reduction in initiation 7% increase in cessation rates
Low		2% reduction in initiation 2% increase in cessation rates
Enforcement level	Government agency is designated to enforce and publicize the laws	Effects reduced by as much as 50% if zero enforcement

Table adjusted from Nagelhout et al. [24] re-used and adjusted with permission of the author.
***** Unless otherwise specified, the same percentage effect is applied as a percentage reduction in the prevalence and initiation rate and a percentage increase in the cessation rate, and is applied to all ages and both genders. The effect sizes are shown relative to the absence of any policy. They are based on literature reviews, advice of an expert panel and model validation

Increasing taxation will help tobacco users quit, reduce the number of new tobacco users and protect people from second-hand smoke. The MPOWER recommendations state that tax rates for tobacco products should be increased and adjusted periodically to keep pace with inflation and rise faster than consumer purchasing power. The policy package simulations will be executed with an annual 5% and a 10% tax increase. The projected cost of cigarettes can be found in table 5.2.

Table5.2 Projected costs of cigarettes with 5% yearly tax increase

	2015	2017	2020	2030	2040	2050
Minimum tax 1000 cigarettes	€181.53	€190.61	€243.27	€359.42	€585.45	€953.64
Minimum tax pack 19 cigarettes	€3.45	€3.62	€4.19	€6.83	€11.12	€18.12
Trading margin*	€1.67	€1.67	€1.67	€1.67	€1.67	€1.67
VAT pack 19 cigarettes	€1.08	€1.11	€1.23	€1.78	€2.69	€4.16
Total cost	€6.20	€6.40	€7.09	€10.28	€15.48	€23.95
% tax of total cost	55.7	56.6	59.1	66.4	71.4	75.7
% tax+VAT of total cost	73.0	73.9	76.4	83.8	89.2	93.0
% price increase	0.00	3.37	3.52	3.98	4.32	4.56

*estimated from Marlboro cigarette pack 19 pieces 2015, kept constant in projected years

Table 5.3 Projected costs of cigarettes with 10% yearly tax increase

	2015	2017	2020	2030	2040	2050
Minimum tax 1000 cigarettes	€181.53	€199.68	€265.78	€689.36	€1788.02	€4637.67
Minimum tax pack 19 cigarettes	€3.45	€3.79	€5.05	€13.10	€33.97	€88.12
Trading margin*	€1.67	€1.67	€1.67	€1.67	€1.67	€1.67
VAT pack 19 cigarettes	€1.08	€1.15	€1.41	€3.10	€7.49	€8.86
Total cost	€6.20	€6.61	€8.13	€17.87	€43.13	€108.64
% tax of total cost	55.7	57.4	62.1	73.3	78.8	81.1
% tax+VAT of total cost	73.0	74.7	79.5	90.6	96.1	98.5
% price increase	0.00	6.74	7.33	8.77	9.49	9.80

*estimated from Marlboro cigarette pack 19 pieces 2015, kept constant in projected years

The current and project levels of the MPOWER policies within the SimSmoke model can be found in table 5.4. The Dutch government has already decided to implement graphic health warnings in 2016. It is expected that packages with graphic health warnings will replace the 'old' packages during the second half of 2016. Therefore, we set the level of implementation graphic health warnings in the year 2016 at 50% and from 2017 and onwards at 100%.

Table 5.4 Current and projected SimSmoke parameter levels

	Reference scenario 2015 level	Projected level from 2017 onwards
Tax increase		
Annual tax increase	-	5%-10% (annually)
Clean air laws		
Ban in all workplaces	0%	100%
Ban in indoor offices	100%	100%
Ban in health facilities, universities and government facilities	0%	100%
Ban in restaurants	50%	100%
Ban in pubs and bars	0%	100%
Ban in schools	100%	100%
Enforcement	5	10
Mass media campaign		
Well-funded media/tobacco control campaign	0%	100%
Moderately funded media/tobacco control campaign	100%	0%

Advertising ban		
Ban on direct and indirect marketing	0%	100%
Ban on advertising	50%	100%
Partial ban on advertising	50%	0%
Enforcement	5	10
Health warnings*		
Strong health warnings	0%	100%
Moderately health warnings	100%	0%
Youth access enforcement		
Vending machine ban	0%	100%
Self-service ban	0%	100%
Strongly enforced & publicized youth access enforcement	0%	100%
Well enforced youth access enforcement	100%	0%
Community based publicity campaign	0%	100%
Cessation treatment		
Availability of pharmacotherapy	yes	yes
Financial coverage of treatments	yes	yes
Passive quit line	yes	yes
Health care provider involvement	no	yes
Retailer restrictions		
Strong restrictions	0%	100%
Low restrictions	100%	0%
Enforcement level	5	10

*In 2016, it is expected that graphic warnings will be placed on the cigarette packages. Therefore we calculated with 50% strong health warnings and 50% moderately health warnings in 2016 only. From 2017 this policy measure will be integrated and effective at full level.

Content policy package

The policy consists of excise tax increase (in this study we have examined 5% and 10% increase). Furthermore, the package consists of law enforcements, i.e. smoke-free air laws, comprehensive advertisement marketing ban, strong youth access enforcement and strong retailer enforcements. Lastly, the package highly recommends including effective smoking cessation programs to be reimbursed by medical care. However, in the Netherlands, effective smoking cessation programs are currently already within the health insurance package (see table 5.4).

SimSmoke and CDM

As indicated earlier, the SimSmoke model is used to examine the potential effect of a tobacco control policy package on smoking prevalence. However, the SimSmoke model does not examine the effects on QALYs and does not estimate health care costs due to (smoking-attributable) chronic diseases. Therefore, the outcomes of the SimSmoke projections are used as 'calibration-parameters' in the CDM. The relative change in smoking prevalence due to a policy package projected by SimSmoke is re-modeled with the CDM (see appendix D for details). Following this method, we were able to estimate QALYs and health care costs (See Figure 5.2). Furthermore, in this way the reference

scenario and the projected effects on prevalence, QALYs and health care costs of a policy package are comparable as the same population model of the CDM is underlying the estimate.

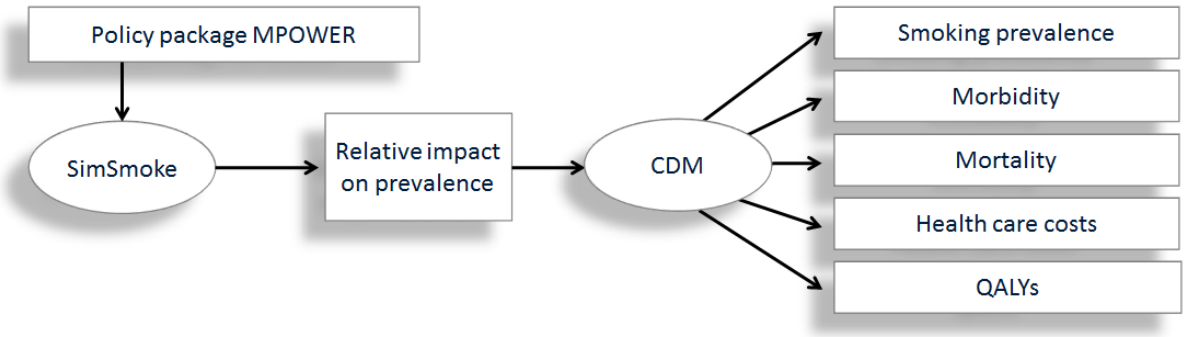


Figure 5.2 A graphical presentation of the combination of SimSmoke and CDM used to estimate the impact of a policy package

5.1.2 Smoking prevalence

Analysing the policies separately, it is shown that increasing taxes has the largest effect on smoking prevalence of all MPOWER policies. A complete ban on smoking in worksites, bars, restaurants and other public places, along with strong enforcement, is predicted to be the second most influential policy. Then, a comprehensive advertising and marketing ban, strong youth access enforcement and strong retailer restrictions, reach similar effects. A mass media campaign will reach the same magnitude of effects as implementing graphic health warnings. The MPOWER combination of ready availability of nicotine replacement therapy and bupropion, the provision of (passive) quit lines, the provision of cessation treatment and the financial coverage of those treatments is projected to have the smallest impact on smoking prevalence. This decrease in future years is relatively small because the Dutch government has already implemented the financial coverage for cessation treatment in the reference scenario.

Policy package with annual 5% tax increase

The full package scenario, including an annual 5% tax increase, projects the effect of implementing all previously described MPOWER policies in 2017 and the underlying (partial) additive and/or synergistic effects between the single policies. Under the influence of the policy package, smoking prevalence is decreased from 19.8% in the reference scenario to 19.6%, by 2017 to 18.8%, by 2020 to 15.1%, by 2030 to 11.1%, by 2040 and to 7.7% by 2050 (See Table 5.5).

Table 5.5 Scenario MPOWER policy package with 5% tax increase: Gender specific smoking prevalence projections

	2015	2017	2020	2030	2040	2050
Male smokers	21.9%	21.6%	20.7%	16.6%	12.1%	8.3%
Female smokers	17.8%	17.6%	16.9%	13.6%	10.1%	7.0%
All smokers	19.8%	19.6%	18.8%	15.1%	11.1%	7.7%
Male ex-smokers	28.9%	28.7%	28.6%	28.2%	27.0%	25.1%
Female ex-smokers	29.0%	28.9%	28.8%	28.4%	26.5%	23.7%
All ex-smokers	28.9%	28.8%	28.7%	28.3%	26.8%	24.4%
Male never smokers	49.2%	49.7%	50.7%	55.2%	60.9%	66.7%
Female never smokers	53.2%	53.5%	54.2%	58.0%	63.4%	69.3%
All never smokers	51.2%	51.6%	52.4%	56.6%	62.1%	68.0%

Policy package with annual 10% tax increase

With the full set of MPOWER policies and an annual tax increase of 5%, the goal of a smoke-free Netherlands will not be reached. In order to come closer to this ultimate goal, the full MPOWER package is modelled with an annual tax increase of 10%. Under the influence of the policy package, smoking prevalence is decreased from 19.8% in the reference scenario to 19.5%, by 2017 to 18.7%, by 2020 to 14.1%, by 2030 to 9.3%, by 2040 and to 5.6% by 2050 (See Table 5.6).

Table 5.6 Scenario MPOWER policy package with 10% tax increase: Gender specific smoking prevalence projections

	2015	2017	2020	2030	2040	2050
Male smokers	21,9%	21,5%	20,6%	15,5%	10,1%	6,0%
Female smokers	17,8%	17,5%	16,8%	12,7%	8,5%	5,2%
All smokers	19,8%	19,5%	18,7%	14,1%	9,3%	5,6%
Male ex-smokers	28,9%	28,7%	28,7%	28,7%	27,7%	25,3%
Female ex-smokers	29,0%	28,9%	28,9%	28,8%	27,1%	23,8%
All ex-smokers	28,9%	28,8%	28,8%	28,8%	27,4%	24,6%
Male never smokers	49,2%	49,7%	50,7%	55,8%	62,2%	68,7%
Female never smokers	53,2%	53,5%	54,3%	58,4%	64,4%	70,9%
All never smokers	51,2%	51,6%	52,5%	57,1%	63,3%	69,8%

5.1.3 Health care impact

Table 5.7 presents the prevalence of smoking-related diseases within the entire population, estimated for future years with a MPOWER policy package with 5% tax increase.

Table 5.7 Scenario MPOWER policy package with 5% tax increase: Prevalence smoking-related diseases

Chronic diseases	2015	2017	2020	2030	2040	2050
Lung cancer	0.22%	0.22%	0.23%	0.25%	0.23%	0.19%
Stomach cancer	0.04%	0.04%	0.04%	0.04%	0.05%	0.05%
Oesophagus cancer	0.05%	0.05%	0.05%	0.06%	0.06%	0.05%
Larynx cancer	0.05%	0.05%	0.05%	0.05%	0.05%	0.04%
Bladder cancer	0.12%	0.12%	0.13%	0.15%	0.16%	0.16%
Kidney cancer	0.12%	0.12%	0.12%	0.13%	0.13%	0.13%
Pancreas cancer	0.02%	0.02%	0.02%	0.03%	0.03%	0.03%
Oral cavity cancer	0.03%	0.03%	0.03%	0.03%	0.02%	0.02%
Myocardial infarction	4.01%	4.10%	4.23%	4.56%	4.59%	4.41%
Congestive heart failure	0.92%	0.96%	1.02%	1.24%	1.38%	1.42%
Stroke	1.37%	1.44%	1.54%	1.80%	1.89%	1.86%
COPD	2.55%	2.66%	2.83%	3.14%	3.07%	2.80%
Diabetes	5.50%	5.66%	5.87%	6.39%	6.56%	6.52%

Table 5.8 presents the prevalence of smoking-related diseases within the entire population, estimated for future years with a MPOWER policy package with 10% tax increase.

Table 5.8 Scenario MPOWER policy package with 10% tax increase: Prevalence smoking attributable diseases

Chronic diseases	2015	2017	2020	2030	2040	2050
Lung cancer	0.22%	0.22%	0.23%	0.25%	0.23%	0.19%
Stomach cancer	0.04%	0.04%	0.04%	0.04%	0.05%	0.05%
Oesophagus cancer	0.05%	0.05%	0.05%	0.06%	0.06%	0.05%
Larynx cancer	0.05%	0.05%	0.05%	0.05%	0.05%	0.04%
Bladder cancer	0.12%	0.12%	0.13%	0.15%	0.16%	0.15%
Kidney cancer	0.12%	0.12%	0.12%	0.13%	0.13%	0.13%
Pancreas cancer	0.02%	0.02%	0.02%	0.03%	0.03%	0.03%
Oral cavity cancer	0.03%	0.03%	0.03%	0.03%	0.02%	0.02%
Myocardial infarction	4.01%	4.10%	4.23%	4.55%	4.58%	4.38%
Congestive heart failure	0.92%	0.96%	1.02%	1.24%	1.38%	1.42%
Stroke	1.37%	1.44%	1.54%	1.80%	1.89%	1.85%
COPD	2.55%	2.66%	2.83%	3.14%	3.05%	2.77%
Diabetes	5.50%	5.66%	5.87%	6.39%	6.56%	6.52%

Table 5.9 and table 5.10 presents the health care costs based on the smoking-attributable costs and the health care costs caused by (al) other diseases for the MPOWER policy package scenarios with 5% and 10% tax increase.

Table 5.9 Scenario MPOWER policy package with 5% tax increase: Health care costs in absolute numbers per year (million Euros) and the number of smoking-related deaths

	2015	2017	2020	2030	2040	2050
Smoking-related diseases	8347	8230	8012	6874	5285	3803
Other diseases	90501	87578	83150	68352	53148	39703
Smoking-related deaths	14509	15928	17398	17425	8176	-2596*

* Negative value because if people would never have smoked, they would have lived longer and would die later. Hence, the number of deaths in 2050 would be higher compared to a situation with smoking.

Table 5.10 Scenario MPOWER policy package with 10% tax increase: Health care costs in absolute numbers per year (million Euros) and the number of smoking-related deaths

	2015	2017	2020	2030	2040	2050
Smoking-related diseases	8347	8230	8012	6870	5274	3787
Other diseases	90501	87578	83150	68354	53158	39728
Smoking-related deaths	14509	15928	17395	17345	7897	-3044*

* Negative value because if people would never have smoked, they would have lived longer and would die later. Hence, the number of deaths in 2050 would be higher compared to a situation with smoking.

Other smoking-attributable diseases

Table 5.11 - 5.14 present the smoking number of patients and smoking-attributable health care costs for Alzheimer and eye diseases.

Table 5.11 Scenario MPOWER policy package with 5% tax increase: Number of Alzheimer patients and smoking-attributable health care costs per year million €)

	2015	2017	2020	2030	2040	2050
Non-smoking Alzheimer patients	46814	49787	54309	70803	81646	85718
Smoking Alzheimer patients	10584	10811	11016	10643	8415	5670
Attributable to smoking	6304	6262	6093	5007	3688	2521
Attributable to other factors	4279	4549	4923	5636	4727	3149
Non-smoking Alzheimer costs	€ 2.013	€ 2.018	€ 2.015	€ 1.954	€ 1.677	€ 1.310
Smoking Alzheimer costs	€ 455	€ 438	€ 409	€ 294	€ 173	€ 87
Attributable to smoking	€ 271	€ 254	€ 226	€ 138	€ 76	€ 39
Attributable to other factors	€ 184	€ 184	€ 183	€ 156	€ 97	€ 48

Table 5.12 Scenario MPOWER policy package with 5% tax increase: Number of eye disease patients and smoking-attributable health care costs per year (million €)

	2015	2017	2020	2030	2040	2050
Non-smoking eye disease patients	57576	60958	65950	82363	91919	93516
Smoking eye disease patients	17967	18231	18334	16723	12797	8605
Attributable to smoking	11395	11319	11014	9051	6666	4558
Attributable to other factors	6571	6912	7320	7672	6131	4047
Non-smoking eye disease costs	€ 393	€ 392	€ 388	€ 360	€ 299	€ 227
Smoking eye disease costs	€ 120	€ 115	€ 106	€ 72	€ 41	€ 20
Attributable to smoking	€ 75	€ 70	€ 62	€ 38	€ 21	€ 11
Attributable to other factors	€ 45	€ 44	€ 43	€ 34	€ 20	€ 10

Table 5.13 Scenario MPOWER policy package with 10% tax increase: Number of Alzheimer patients and smoking-attributable health care costs per year (million €)

	2015	2017	2020	2030	2040	2050
Non-smoking Alzheimer patients	46814	49787	54309	70805	81668	85806
Smoking Alzheimer patients	10584	10800	10931	9996	7188	4362
Attributable to smoking	6304	6255	6043	4672	3088	1848
Attributable to other factors	4279	4545	4889	5324	4100	2514
Non-smoking Alzheimer costs	€2.013	€ 2.018	€ 2.015	€ 1.954	€ 1.677	€ 1.311
Smoking Alzheimer costs	€ 455	€ 438	€ 405	€ 276	€ 148	€ 67
Attributable to smoking	€ 271	€ 254	€ 224	€ 129	€ 63	€ 28
Attributable to other factors	€ 184	€ 184	€ 181	€ 147	€ 84	€ 38

Table 5.14 Scenario MPOWER policy package with 10% tax increase: Number of eye disease patients and smoking-attributable health care costs per year (million €)

	2015	2017	2020	2030	2040	2050
Non-smoking eye disease patients	57576	60958	65950	82366	91944	93607
Smoking eye disease patients	17967	18214	18194	15703	10909	6563
Attributable to smoking	11395	11308	10923	8445	5582	3340
Attributable to other factors	6571	6906	7271	7258	5327	3223
Non-smoking eye disease costs	€ 393	€ 392	€ 388	€ 360	€ 299	€ 227
Smoking eye disease costs	€ 120	€ 114	€ 105	€ 67	€ 35	€ 16
Attributable to smoking	€ 75	€ 70	€ 62	€ 36	€ 18	€ 8
Attributable to other factors	€ 45	€ 44	€ 43	€ 32	€ 17	€ 8

5.1.4 Consumer surplus

Similar to the scenarios discussed in Chapter 4.1. the consumer surplus for the MPOWER policy package including 5% and 10% tax increase scenarios was only estimated based on the incremental difference compared to the reference scenario.

Table 5.15 Scenario MPOWER policy package with 5% tax increase vs. reference scenario: Incremental effects on consumer surplus per year in million Euros

	2015	2017	2020	2030	2040	2050
Consumer surplus	0.0	-80.2	-310.9	-939.4	-1373.3	-1700.9

Table 5.16 Scenario MPOWER policy package with 10% tax increase vs. reference scenario: Incremental effects on consumer surplus per year in million Euros

	2015	2017	2020	2030	2040	2050
Consumer surplus	0.0	-336.7	-877.1	-2953.0	-5687.6	-9957.9

5.1.5 Quality adjusted life years

Estimates of the total number of QALYs and their monetary values for the MPOWER policy package scenario with a 5% and 10% annual tax increase can be found in table 5.17 and 5.18.

Table 5.17 Scenario MPOWER policy package with 5% tax increase: Total QALYs and their monetary value per year in billion Euros

	2015	2017	2020	2030	2040	2050
Number QALYs	13910896	13971734	14045443	14157594	14111966	14023145
Value €50,000	696	658	606	454	337	249
Value €100,000	1391	1317	1212	909	674	498

Table 5.18 Scenario MPOWER policy package with 10% tax increase: Total QALYs and their monetary value per year in billion Euros

	2015	2017	2020	2030	2040	2050
Number QALYs	13910896	13971734	14045455	14158250	14115114	14030576
Value €50,000	696	658	606	454	337	249
Value €100,000	1391	1317	1212	909	674	499

5.1.6 Productivity

Estimates of the total productivity transfers for the MPOWER policy package scenario with 5% and 10% annual tax increase can be found in table 5.19 and 5.20. As the policies are being introduced in 2017, there is no difference in absenteeism or presenteeism between the policy and the reference scenario in the year 2015 or 2017.

Table 5.19 Scenario MPOWER policy package with 5% tax increase: Production losses per year

	2015	2017	2020	2030	2040	2050
Direct methods						
Absenteeism and presenteeism	7515	7036	6266	3831	2100	1068
Productivity transfers	186484	176677	162451	120272	88636	66212
(Old age-) pensions	41208	41120	40230	35574	28356	20116
Indirect method						
Absenteeism and presenteeism	5598	5272	4824	3493	2701	2046
Total production losses	240805	230106	213771	163171	121792	89442

Table 5.20 Scenario MPOWER policy package with 10% tax increase: Production losses per year in million euros

	2015	2017	2020	2030	2040	2050
Direct methods						
Absenteeism and presenteeism	7515	7029	6214	3575	1758	783
Productivity transfers	186484	176677	162451	120275	88646	66232
(Old age-) pensions	41208	41120	40230	35575	28363	20134
Indirect method						
Absenteeism and presenteeism	5598	5272	4824	3500	2719	2077
Total production losses	240805	230098	213719	162925	121487	89225

5.1.7 Government

The government income will change in future years from €3,737 million in 2015 to €2,930 million by 2050 for the MPOWER policy package with 5% tax and to €103,939 million by 2050 for the MPOWER policy package with 10% tax (see Table 5.21 & 5.22).

Actual government incomes will be lower, as border effects and smuggling will lead to a loss of income.

Table 5.21 Scenario MPOWER policy package with 5% tax increase: Government income due to excise tax on tobacco products per year in million Euros

	2015	2017	2020	2030	2040	2050
Excise tax	2632	2588	2667	2657	2372	1965
Total incl. correction factor	3737	3674	3788	3773	3368	2791

Table 5.22 Scenario MPOWER policy package with 10% tax increase: Government income due to excise tax on tobacco products per year in million Euros

	2015	2017	2020	2030	2040	2050
Excise tax	2632	2979	3505	5230	6672	7704
Total incl. correction factor	3737	4230	4977	7426	9474	10939

5.1.8 Others in society

Fire damages

The effects of the policy scenarios via smoking prevalence on total fire damages insurance claims can be found in table 5.23 and 5.24.

Table 5.23 Scenario MPOWER policy package with 5% tax increase: Total costs indoor fires due to smoking per year in million euros

	2015	2017	2020	2030	2040	2050
Total costs	60	56	50	31	17	9

Table 5.24 Scenario MPOWER policy package with 10% tax increase: Total costs indoor fires due to smoking per year in million euros

	2015	2017	2020	2030	2040	2050
Total costs	60	56	50	29	14	6

Passive smoking & smoking during pregnancy

Effects on passive smoking & smoking during pregnancy are not estimated nor monetarised in this SCBA report

Environment

The effects of the policy scenarios via smoking prevalence on environmental costs can be found in table 5.25 and 5.26.

Table 5.25 Scenario MPOWER policy package with 5% tax increase: Total costs environment per year in million euros

	2015	2017	2020	2030	2040	2050
Total costs	63	59	52	32	18	9

Table 5.26 Scenario MPOWER policy package with 10% tax increase: Total costs environment per year in million euros

	2015	2017	2020	2030	2040	2050
Total costs	63	59	52	30	15	7

5.1.9 Intervention costs

It is assumed that the intervention costs of the MPOWER policy package are equal to the costs of an MMC (i.e. the high intensity tobacco control campaign). We assume that the costs of an excise tax increase will be negligible. In addition, we assume that the law enforcements, i.e. smoke-free air laws, comprehensive advertisement marketing ban, strong youth access enforcement and strong retailer enforcements will not lead to more work for law enforcement agencies. It is expected that the same level of law enforcement will be sufficient to maintain the new laws as the level of enforcement is already high in the Netherlands [8]. Lastly, effective smoking cessation programs are currently already within the health insurance package in the Netherlands. In 2010, the "College voor zorgverzekeringen" estimated that an average quit attempt would costs €247 (€226 price index year 2010) per person. Yearly total costs of smoking cessation in the insurance package would be between €21.8 million and 36 million (€20 million and €33 million price index year 2010) [124].

5.1.10 Net present value

An overview of costs and benefits to society are presented in table 5.27, table 5.28, table 5.29 and table 5.50 for respectively the MPOWER policy package scenarios with annual 5% tax increase and 10% tax increase compared to the reference scenario. All costs are presented in million Euros, indexed to 2015 and discounted at 3%.

Table 5.27 Net present value: Total reference scenario costs and increments of Scenario MPOWER policy package with 5% tax increase vs. reference scenario per year in million euros

		2030		2040		2050	
		Total	Incr.	Total	Incr.	Total	Incr.
Consumers	Value of total QALYs (€50.000)	454361	66.7	336998	269.9	249180	562.5
	Value of consumer surplus*	*	-939.4	*	-1373.3	*	-1700.9
Producers	Producer surplus	P.m.	P.m.	P.m.	P.m.	P.m.	P.m.
Employers	Absenteeism and presenteeism	3831	-759.4	2100	-1222.9	1068	-1377.1
	Absenteeism due to chronic diseases	3493	21.5	2701	67.5	2046	133.3
Others in society	Fire damage costs	31	-6.1	17	-9.8	9	-11.0
	Environmental costs	32	-6.4	18	-10.2	9	-11.5
Health care	Smoking related health care costs	6874	-12.3	5285	-41.8	3803	-75.6
	Other diseases health care costs	68352	5.5	53148	36.6	39703	103.0
	Smoking related Alzheimer costs	138	-27.4	76	-44.1	39	-49.7
	Smoking related eye disease costs	38	-7.6	21	-12.2	11	-13.7
Public Authority	Intervention costs	4	3.9	3	2.9	2	2.2
	Enforcement costs	P.m.	P.m.	P.m.	P.m.	P.m.	P.m.
Taxes and duties	Government income	3773	1489.5	3368	1715.4	2791	1574.6
	(Old-age-) pensions transfers	35574	3.6	28356	27.4	20116	72.8
	Productivity transfers	120272	8.2	88636	36.2	66212	81.5

* Only estimated as incremental effect

Table5.28 Overview of social costs and benefits: Scenario MPOWER policy package with 5% tax increase vs. Reference scenario per year in million euros

		2015	**2017**	**2020**	**2030**	**2040**	**2050**
Consumers	Value of gained total QALYs (€50.000)	0.0	0.0	1.5	66.7	269.9	562.5
	Value of consumer surplus	0.0	-80.2	-310.9	-939.4	-1373.3	-1700.9
Producers	Producer surplus	P.m.	P.m.	P.m.	P.m.	P.m.	P.m.
Employers	Savings absenteeism and presenteeism	0.0	20.3	142.7	759.4	1222.9	1377.1
	Savings absenteeism due to chronic diseases	0.0	0.0	-0.6	-21.5	-67.5	-133.3
Others in society	Savings fire damage	0.0	0.2	1.1	6.1	9.8	11.0
	Savings environment	0.0	0.2	1.2	6.4	10.2	11.5
Health care	Savings smoking related health care costs	0.0	0.0	0.3	12.3	41.8	75.6
	Savings other diseases health care costs	0.0	0.0	-0.1	-5.5	-36.6	-103.0
	Savings smoking related Alzheimer	0.0	0.7	5.1	27.4	44.1	49.7

	costs						
	Savings smoking related eye disease costs	0.0	0.2	1.4	7.6	12.2	13.7
Public Authority	Intervention costs	0.0	-5.8	-5.3	-3.9	-2.9	-2.2
	Enforcement costs	P.m.	P.m.	P.m.	P.m.	P.m.	P.m.
Taxes and duties	Gained government income	0.0	164.9	600.5	1489.5	1715.4	1574.6
	Savings (old-age-) pensions	0.0	0.0	0.0	-3.6	-27.4	-72.8
	Gained productivity transfers	0.0	0.0	0.2	8.2	36.2	81.5
Total		0.0	100.4	437.2	1409.6	1854.7	1744.9

**Negative values (savings) represent extra costs compared to the reference scenario*

Table 5.29 Net present value: Total reference scenario costs and increments of Scenario MPOWER policy package with 10% tax increase vs. reference scenario per year in million euros

		2030		2040		2050	
		Total	Incr.	Total	Incr.	Total	Incr.
Consumers	Value of total QALYs (€50.000)	454382	87.8	337073	345.0	249312	694.5
	Value of consumer surplus*	*	-2953	*	-5688	*	-9958
Producers	Producer surplus	P.m.	P.m.	P.m.	P.m.	P.m.	P.m.
Employers	Absenteeism and presenteeism	3575	-1016.1	1758	-1564.3	783	-1662.5
	Absenteeism due to chronic diseases	3500	28.3	2719	86.0	2077	163.6
Others in society	Fire damage costs	29	-8.1	14	-12.5	6	-13.3
	Environmental costs	30	-8.5	15	-13.1	7	-13.9
Health care	Smoking related health care costs	6870	-16.1	5274	-53.1	3787	-92.1
	Other diseases health care costs	68354	7.3	53158	47.1	39728	128.6
	Smoking related Alzheimer costs	129	-36.7	63	-56.4	28	-60.0
	Smoking related eye disease costs	36	-10.1	18	-15.6	8	-16.6
Public Authority	Intervention costs	4	3.9	3	2.9	2	2.2
	Enforcement costs	P.m.	P.m.	P.m.	P.m.	P.m.	P.m.
Taxes and duties	Government income	7426	5143.1	9474	7821.7	10939	9723.0
	(Old-age-) pensions transfers	35575	4.8	28363	35.3	20134	90.9
	Productivity transfers	120275	10.8	88646	46.4	66232	101.2

* Only estimated as incremental effect

Table 5.30 Overview of social costs and benefits: Scenario MPOWER policy package with 10% tax increase vs. Reference scenario per year in million euros

		2015	2017	2020	2030	2040	2050
Consumers	Value of gained total QALYs (€50.000)	0.0	0.0	2.0	87.8	345.0	694.5
	Value of consumer surplus	0,0	-336.7	-877.1	-2953.0	-5687.6	-9957.9
Producers	Producer surplus	P.m.	P.m.	P.m.	P.m.	P.m.	P.m.
Employers	Savings absenteeism and presenteeism	0.0	27.6	194.5	1016.1	1564.3	1662.5
	Savings absenteeism due to chronic diseases	0.0	0.0	-0.8	-28.3	-86.0	-163.6
Others in society	Savings fire damage	0.0	0.2	1.6	8.1	12.5	13.3
	Savings environment	0.0	0.2	1.6	8.5	13.1	13.9

Health care	Savings smoking related health care costs	0.0	0.0	0.4	16.1	53.1	92.1
	Savings other diseases health care costs	0.0	0.0	-0.1	-7.3	-47.1	-128.6
	Savings smoking related Alzheimer costs	0.0	1.0	7.0	36.7	56.4	60.0
	Savings smoking related eye disease costs	0.0	0.3	1.9	10.1	15.6	16.6
Public Authority	Intervention costs	0.0	-5.8	-5.3	-3.9	-2.9	-2.2
	Enforcement costs	P.m.	P.m.	P.m.	P.m.	P.m.	P.m.
Taxes and duties	Gained government income	0.0	720.4	1789.9	5143.1	7821.7	9723.0
	Savings (old-age-) pensions	0.0	0.0	-0.1	-4.8	-35.3	-90.9
	Gained productivity transfers	0.0	0.0	0.2	10.8	46.4	101.2
Total		0.0	407.2	1115.8	3340.1	4069.3	2034.0

**Negative values (savings) represent extra costs compared to the reference scenario*

5.1.11 Cumulative net present value

The cumulative costs and benefits for the scenario MPOWER policy package with 5% and 10% excise tax increase per year are provided in table 5.31 and 5.32.

Table 5.31 Cumulative social costs and benefits: Scenario MPOWER policy package with 5% tax increase vs. Reference scenario - million €

		2020	2030	2040	2050
Consumers	Value of total QALYs (€50.000)	2	273	1949	6221
	Value of consumer surplus	-786	-7540	-19443	-35035
Producers	Producer surplus	p.m.	p.m.	p.m.	p.m.
Employers	Absenteeism and presenteeism	310	5073	15,459	28,784
	Absenteeism due to chronic diseases	-1	-95	-547	-1575
Others in society	Fire damage costs	2	41	124	231
	Environmental costs	3	42	129	241
Healthcare	Smoking related health care costs	0	52	329	933
	Other diseases health care costs	0	-20	-215	-925
	Smoking related Alzheimer costs	11	183	558	1038
	Smoking related eye disease costs	3	51	154	287
Public Authority (Government)	Intervention costs	19	46	59	62
	Enforcement costs	p.m.	p.m.	p.m.	p.m.
Taxes and duties	Government income	2477	15959	34295	52403
	(Old-age-) pensions transfers	0	-12	-156	-669
	Productivity transfers	0	32	251	853
Total		2041	14,085	32,946	52,850

**Negative values (savings) represent extra costs compared to the reference scenario*

Table 5.32 Cumulative social costs and benefits: Scenario MPOWER policy package with 10% tax increase vs. Reference scenario - million €

		2020	2030	2040	2050
Consumers	Value of total QALYs (€50.000)	3	361	2527	7877
	Value of consumer surplus	-2584	-22418	-66178	-144738
Producers	Producer surplus	p.m.	p.m.	p.m.	p.m.
Employers	Absenteeism and presenteeism	423	6850	20411	36922
	Absenteeism due to chronic diseases	-1	-126	-708	-1988
Others in society	Fire damage costs	3	55	164	296
	Environmental costs	4	57	171	309
Healthcare	Smoking related health care costs	1	69	424	1173
	Other diseases health care costs	0	-26	-280	-1176
	Smoking related Alzheimer costs	15	247	736	1332
	Smoking related eye disease costs	4	68	204	368
Public Authority (Government)	Intervention costs	19	46	59	62
	Enforcement costs	p.m.	p.m.	p.m.	p.m.
Taxes and duties	Government income	5384	42144	108946	198222
	(Old-age-) pensions transfers	0	-16	-202	-851
	Productivity transfers	0	43	326	1084
Total		3270	27,356	66,598	98,892

**Negative values (savings) represent extra costs compared to the reference scenario*

5.1.12 Sensitivity analyses

The results of the probabilistic sensitivity analysis are provided below. The results of the one-way sensitivity analyses (i.e. different WTP values for QALYs and the in-/exclusion of the consumer surplus) can be found in Chapter 7.5.

Probabilistic sensitivity analyses

Table 5.33 Confidence intervals (CI) for the incremental costs of scenario MPOWER policy package with 5% tax increase vs. Reference scenario based on PSA per year (in millions)

		2015	2017	2020	2030	2040	2050
Consumers	Base case	0.0	-80.2	-309.4	-872.7	-1103.4	-1138.5
95%CI	Lower bound	0.0	-80.3	-310.0	-877.9	-1120.0	-1170.6
	Upper bound	0.0	-80.1	-308.8	-867.7	-1086.3	-1103.3
Producers	Base case (Fixed)	P.m.	P.m.	P.m.	P.m.	P.m.	P.m.
Employers	Base case	0.0	20.3	142.1	737.9	1155.4	1243.8
95%CI	Lower bound	0.0	20.2	141.9	734.9	1144.6	1221.4
	Upper bound	0.0	20.3	142.3	739.9	1161.7	1256.3
Others in society	Base case	0.0	0.3	2.3	12.4	20.0	22.6
95%CI	Lower bound	0.0	0.3	2.3	12.4	20.0	22.5
	Upper bound	0.0	0.3	2.3	12.5	20.1	22.6
Health care	Base case	0.0	0.9	6.8	41.7	61.5	36.0
95%CI	Lower bound	0.0	0.9	6.8	41.5	59.0	27.1
	Upper bound	0.0	0.9	6.9	43.6	71.1	56.0

Public authority	Base case (Fixed)	0.0	-5.8	-5.3	-3.9	-2.9	-2.2
Taxes and duties	Base case	0.0	164.9	600.7	1494.1	1724.2	1583.3
95%CI	Lower bound	0.0	164.8	600.2	1491.2	1719.6	1578.2
	Upper bound	0.0	164.9	601.1	1497.9	1731.2	1592.1
Total	Base case	0.0	100.4	437.2	1409.6	1854.7	1744.9
95%CI	Lower bound	0.0	100.3	437.1	1407.6	1851.5	1735.6
	Upper bound	0.0	100.5	437.3	1412.5	1863.5	1761.9

Table 5.34 Confidence intervals (CI) for the incremental costs of scenario MPOWER policy package with 10% tax increase vs. Reference scenario based on PSA per year (in millions)

		2015	**2017**	**2020**	**2030**	**2040**	**2050**
Consumers	Base case	0.0	-336.7	-875.1	-2865.2	-5342.6	-9263.4
95%CI	Lower bound	0.0	-337.2	-876.8	-2877.4	-5375.8	-9319.6
	Upper bound	0.0	-336.1	-873.3	-2854.7	-5312.5	-9205.1
Producers	Base case (Fixed)	P.m.	P.m.	P.m.	P.m.	P.m.	P.m.
Employers	Base case	0.0	27.6	193.7	987.8	1478.4	1499.0
95%CI	Lower bound	0.0	27.5	193.4	983.8	1464.6	1470.9
	Upper bound	0.0	27.6	193.9	990.7	1486.5	1514.5
Others in society	Base case	0.0	0.5	3.2	16.7	25.6	27.2
95%CI	Lower bound	0.0	0.5	3.2	16.6	25.6	27.2
	Upper bound	0.0	0.5	3.2	16.7	25.7	27.3
Health care	Base case	0.0	1.3	9.3	55.6	78.0	40.1
95%CI	Lower bound	0.0	1.3	9.3	55.3	74.7	28.6
	Upper bound	0.0	1.3	9.3	58.1	90.1	63.9
Public authority	Base case (Fixed)	0.0	-5.8	-5.3	-3.9	-2.9	-2.2
Taxes and duties	Base case	0.0	720.4	1790.1	5149.1	7832.8	9733.3
95%CI	Lower bound	0.0	720.2	1788.8	5139.8	7814.6	9709.9
	Upper bound	0.0	720.6	1791.4	5160.9	7857.7	9767.4
Total	Base case	0.0	407.2	1115.8	3340.1	4069.3	2034.0
95%CI	Lower bound	0.0	406.9	1115.4	3336.8	4064.5	2022.5
	Upper bound	0.0	407.5	1116.2	3345.1	4081.3	2053.7

6. Part III Alternative scenario: Smoke-free Netherlands

Chapter 6 describes the scenario in which a smoke-free Netherlands is achieved. An overview of the structure of chapter 6 can be found in Figure 6.1.

Figure 6.1 Overview Chapter 6: Single policies

6.1	Smoke-free Netherlands	
	6.1.1	Methods
	6.1.2	Smoking prevalence
	6.1.3	Health care impact
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6.2	No one start smoking	
	6.2.1	Methods
	6.2.2	Smoking prevalence
	6.2.3	Health care impact
	6.2.4	Consumer surplus
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6.1 Smoke-free Netherlands

6.1.1 Methods

A smoke-free Netherlands is described as a population with less than 5% smokers in a certain year. By manually changing the start, stop and relapse transitions within the CDM, we estimated the effects of a smoke-free Netherlands (in 2050). The transition rates are decreased (start and relapse chances) and increased (stop chances) with the same ratio.

6.1.2 Smoking prevalence

Table 6.1 Scenario smoke-free Netherlands: Gender specific smoking prevalence projections

	2015	2017	2020	2030	2040	2050
Male smokers	21.9%	21.4%	19.6%	9.7%	3.6%	2.0%
Female smokers	17.8%	17.4%	16.0%	8.1%	3.3%	2.0%
All smokers	19.8%	19.4%	17.8%	8.9%	3.5%	2.0%
Male ex-smokers	28.9%	28.8%	29.3%	32.2%	29.9%	23.3%
Female ex-smokers	29.0%	29.0%	29.5%	31.7%	28.9%	22.4%
All ex-smokers	28.9%	28.9%	29.4%	32.0%	29.4%	22.9%
Male never smokers	49.2%	49.8%	51.1%	58.1%	66.5%	74.7%
Female never smokers	53.2%	53.6%	54.6%	60.2%	67.8%	75.6%
All never smokers	51.2%	51.7%	52.8%	59.1%	67.1%	75.2%

6.1.3 Health care impact

A decrease in smoking prevalence leads to a change in smoking attributable diseases. Table 6.2 and 6.3 presents the prevalence of smoking attributable disease in the population when a smoke-free Netherlands is reached, along with the health care costs and the smoking related mortality.

Table 6.2 Scenario smoke-free Netherlands: Prevalence smoking attributable diseases

Chronic diseases	2015	2017	2020	2030	2040	2050
Lung cancer	0.22%	0.22%	0.23%	0.25%	0.22%	0.19%
Stomach cancer	0.04%	0.04%	0.04%	0.04%	0.05%	0.05%
Oesophagus cancer	0.05%	0.05%	0.05%	0.06%	0.06%	0.05%
Larynx cancer	0.05%	0.05%	0.05%	0.05%	0.05%	0.04%
Bladder cancer	0.12%	0.12%	0.13%	0.15%	0.16%	0.15%
Kidney cancer	0.12%	0.12%	0.12%	0.13%	0.13%	0.13%
Pancreas cancer	0.02%	0.02%	0.02%	0.03%	0.03%	0.03%
Oral cavity cancer	0.03%	0.03%	0.03%	0.03%	0.02%	0.02%
Myocardial infarction	4.01%	4.10%	4.23%	4.54%	4.54%	4.35%
Congestive heart failure	0.92%	0.96%	1.02%	1.24%	1.38%	1.42%
Stroke	1.37%	1.44%	1.54%	1.79%	1.88%	1.84%
COPD	2.55%	2.66%	2.83%	3.13%	3.00%	2.73%
Diabetes	5.50%	5.66%	5.87%	6.39%	6.55%	6.52%

* the prevalence refers to the total prevalence, attributable and non-attributable to smoking

Table 6.3 Scenario smoke-free Netherlands: Health care costs in absolute numbers per year (Million Euros) and the number of smoking-related deaths

	2015	2017	2020	2030	2040	2050
Smoking-related diseases	8347	8230	8012	6854	5243	3767
Other diseases	90501	87578	83150	68362	53193	39773
Smoking-related deaths	14509	15928	17380	17001	7223	-3111*

* Negative value because if people would never have smoked, they would have lived longer and would die later. Hence, the number of deaths in 2050 would be higher compared to a situation with smoking.

Other smoking-related diseases

Table 6.4 and 6.5 present the smoking number of patients and smoking-attributable health care costs for Alzheimer and eye diseases.

Table 6.4 Scenario smoke-free Netherlands: Number of Alzheimer patients and smoking-attributable health care costs per year (million €)

	2015	2017	2020	2030	2040	2050
Non-smoking Alzheimer patients	46814	49787	54309	70814	81739	85944
Smoking Alzheimer patients	10584	10737	10419	6475	3163	2545
Attributable to smoking	6304	6218	5748	2950	1152	653
Attributable to other factors	4279	4519	4670	3526	2012	1892
Non-smoking Alzheimer costs	€ 2.013	€ 2.018	€ 2.015	€ 1.955	€ 1.679	€ 1.313
Smoking Alzheimer costs	€ 455	€ 435	€ 386	€ 179	€ 65	€ 39
Attributable to smoking	€ 271	€ 252	€ 213	€ 81	€ 24	€ 10
Attributable to other factors	€ 184	€ 183	€ 173	€ 97	€ 41	€ 29

Table 6.5 Scenario smoke-free Netherlands: Number of eye disease patients and smoking-attributable health care costs per year (million €)

	2015	2017	2020	2030	2040	2050
Non-smoking eye disease patients	57576	60958	65950	82377	92026	93759
Smoking eye disease patients	17967	18109	17353	10179	4644	3383
Attributable to smoking	11395	11240	10391	5332	2082	1180
Attributable to other factors	6571	6869	6962	4846	2562	2203
Non-smoking eye disease costs	€ 393	€ 392	€ 388	€ 360	€ 300	€ 227
Smoking eye disease costs	€ 120	€ 114	€ 100	€ 44	€ 15	€ 8
Attributable to smoking	€ 75	€ 70	€ 59	€ 23	€ 7	€ 3
Attributable to other factors	€ 45	€ 44	€ 41	€ 21	€ 8	€ 5

6.1.4 Consumer surplus

Based on the estimate of the consumer surplus in the reference scenario and the number of smokers per year, the incremental effect on the consumer surplus was estimated for the smoke-free Netherlands scenario.

Table 6.6 Scenario smoke-free Netherlands: Incremental effects on consumer surplus per year in million Euros

	2015	2017	2020	2030	2040	2050
Consumer surplus	0.0	-40.0	-285.5	-1339.9	-1531.3	-1245.2

6.1.3 Quality adjusted life years

Estimates of the total number of QALYs and their monetary values for the smoke-free scenario are provided below.

Table 6.7 Scenario smoke-free Netherlands: QALYs and their monetary value per year in billion Euros

	2015	2017	2020	2030	2040	2050
Number QALYs	13910896	13971734	14045520	14161184	14124925	14043308
Value €50,000	696	658	606	454	337	250
Value €100,000	1391	1317	1212	909	675	499

6.1.4 Productivity

Estimates of the total productivity transfers for the Netherlands smoke-free scenario can be found in table 6.8.

Table 6.8 Scenario smoke-free Netherlands: Productivity per year in million euros

	2015	2017	2020	2030	2040	2050
Direct methods						
Absenteeism and presenteeism	7515	6987	5911	2257	656	277
Productivity transfers	186484	176677	162451	120287	88681	66271
(Old age-) pensions	41208	41120	40230	35581	28390	20167
Indirect method						
	5598	5272	4825	3530	2774	2125
Total production losses	240805	230056	213418	161654	120501	88839

6.1.7 Government

Within the smoke-free scenario, the government income based on excise tax is based on the projections of the proportional decline in prevalent smokers in future years. The assumption is made that prices and taxes for tobacco remain constant over the years. In this scenario, the government incomes will decrease in future years from €3737 million in 2015 to €138 million by 2050 in the smoke-free scenario (see Table 6.9).

Table 6.9 Scenario smoke-free Netherlands: Future government income due to excise tax on tobacco products per year in million Euros

	2015	2017	2020	2030	2040	2050
Excise tax	2632	2447	2070	791	230	97
Total incl. correction factor	3737	3475	2940	1123	326	138

6.1.8 Others in society

Fire damages

The effects of the smoke-free scenarios via smoking prevalence on total fire damages insurance claims are

Table 6.10 Scenario smoke-free Netherlands: Total costs indoor fires due to smoking per year in million euros

	2015	2017	2020	2030	2040	2050
Total costs	60	56	47	18	5	2

Passive smoking & smoking during pregnancy

Effects on passive smoking & smoking during pregnancy are not estimated nor monetarised in this SCBA report

Environment

The effects of the smoke-free scenarios via smoking prevalence on environmental costs are described below.

Table 6.11 Scenario smoke-free Netherlands: Total costs environment per year in million euros

	2015	2017	2020	2030	2040	2050
Total costs	63	59	49	19	5	2

6.1.9 Intervention costs

The hypothetical smoke-free scenario is not based on policy evidence and therefore, no intervention costs can be estimated.

6.1.10 Net present value

An overview of costs and benefits to society are presented in table 6.12 and table 6.13 for the scenario smoke-free Netherlands compared with the reference scenario. All costs are presented in million Euros, indexed to 2015 and discounted with 3%.

Table 6.12 Net present value: Total reference scenario costs and increments of Scenario smoke-free Netherlands vs. reference scenario per year in million euros

		2030		2040		2050	
		Total	Incr.	Total	Incr.	Total	Incr.
Consumers	Value of total QALYs (€50.000)	454476	181.9	337307	579.3	249538	920.7
	Value of consumer surplus*	*	-1339.9	*	-1531.3	*	-1245.2
Producers	Producer surplus	P.m.	P.m.	P.m.	P.m.	P.m.	P.m.
Employers	Absenteeism and presenteeism	2257	-2333.6	656	-2666.8	277	-2168.6
	Absenteeism due to chronic diseases	3530	58.1	2774	141.2	2125	211.7
Others in society	Fire damage costs	18	-18.7	5	-21.4	2	-17.4
	Environmental costs	19	-19.5	5	-22.3	2	-18.2
Health care	Smoking related health care costs	6854	-32.6	5243	-83.5	3767	-111.8
	Other diseases health care costs	68362	15.4	53193	81.7	39773	173.5
	Smoking related Alzheimer costs	81	-84.2	24	-96.2	10	-78.2
	Smoking related eye disease costs	23	-23.3	7	-26.6	3	-21.6
Public Authority	Intervention costs	0	0.0	0	0.0	0	0.0
	Enforcement costs	P.m.	P.m.	P.m.	P.m.	P.m.	P.m.
Taxes and duties	Government income	1123	-1160.5	326	-1326.3	138	-1078.5
	(Old-age-) pensions transfers	35581	10.2	28390	61.8	20167	124.2
	Productivity transfers	120287	22.7	88681	80.8	66271	140.1

* Only estimated as incremental effect

Table 6.13 Overview of social costs and benefits: Scenario smoke-free Netherlands vs. Reference scenario per year in million euros

		2015	**2017**	**2020**	**2030**	**2040**	**2050**
Consumers	Value of gained total QALYs (€50.000)	0.0	0.0	4.8	181.9	579.3	920.7
	Value of consumer surplus	0.0	-40.0	-285.5	-1339.9	-1531.3	-1245.2
Producers	Producer surplus	P.m.	P.m.	P.m.	P.m.	P.m.	P.m.
Employers	Savings absenteeism and presenteeism	0.0	69.6	497.2	2333.6	2666.8	2168.6
	Savings absenteeism due to chronic diseases	0.0	0.0	-2.0	-58.1	-141.2	-211.7
Others in society	Savings fire damage	0.0	0.6	4.0	18.7	21.4	17.4
	Savings environment	0.0	0.6	4.2	19.5	22.3	18.2
Health care	Savings smoking related health care costs	0.0	0.0	1.1	32.6	83.5	111.8
	Savings other diseases health care costs	0.0	0.0	-0.3	-15.4	-81.7	-173.5
	Savings smoking related Alzheimer costs	0.0	2.5	17.9	84.2	96.2	78.2
	Savings smoking related eye disease costs	0.0	0.7	5.0	23.3	26.6	21.6
Public Authority	Intervention costs	0.0	0.0	0.0	0.0	0.0	0.0
	Enforcement costs	P.m.	P.m.	P.m.	P.m.	P.m.	P.m.

Taxes and duties	Gained government income	0.0	-34.6	-247.3	-1160.5	-1326.3	-1078.5
	Savings (old-age-) pensions	0.0	0.0	-0.1	-10.2	-61.8	-124.2
	Gained productivity transfers	0.0	0.0	0.5	22.7	80.8	140.1
Total		0.0	-0.6	-0.6	132.3	434.6	643.5

**Negative values (savings) represent extra costs compared to the reference scenario*

6.1.11 Cumulative net present value

The cumulative costs and benefits for the scenario smoke-free Netherlands are provided in table 6.14.

Table 6.14 Cumulative social costs and benefits: Scenario smoke-free Netherlands vs. Reference scenario - million €

		2020	2030	2040	2050
Consumers	Value of total QALYs (€50.000)	7	780	4716	12518
	Value of consumer surplus	-619	-9588	-24767	-38631
Producers	Producer surplus	p.m.	p.m.	p.m.	p.m.
Employers	Absenteeism and presenteeism	1078	16697	43132	67278
	Absenteeism due to chronic diseases	-3	-270	-1315	-3134
Others in society	Fire damage costs	9	134	346	539
	Environmental costs	9	140	361	563
Healthcare	Smoking related health care costs	2	147	762	1774
	Other diseases health care costs	0	-57	-530	-1864
	Smoking related Alzheimer costs	39	602	1556	2427
	Smoking related eye disease costs	11	167	430	671
Public Authority (Government)	Intervention costs	0	0	0	0
	Enforcement costs	p.m.	p.m.	p.m.	p.m.
Taxes and duties	Government income	-536	-8304	-21451	-33459
	(Old-age-) pensions transfers	0	-35	-385	-1365
	Productivity transfers	1	93	622	1772
Total		-4	506	3478	9090

**Negative values (savings) represent extra costs compared to the reference scenario*

6.1.12 Sensitivity analyses

The results of the probabilistic sensitivity analysis are provided below. The results of the one-way sensitivity analyses (i.e. different WTP values for QALYs and the in-/exclusion of the consumer surplus) can be found in Chapter 7.5.

Probabilistic sensitivity analyses

Table 6.15 Confidence intervals (CI) for the incremental costs of scenario smoke-free Netherlands vs. Reference scenario based on PSA per year (in millions)

		2015	2017	2020	2030	2040	2050
Consumers	Base case	0.0	-40.0	-280.7	-1158.0	-952.0	-324.4
95%CI	Lower bound	0.0	-40.0	-281.1	-1167.6	-978.8	-360.6
	Upper bound	0.0	-39.9	-280.1	-1147.4	-916.5	-259.9
Producers	Base case (Fixed)	p.m.	p.m.	p.m.	p.m.	p.m.	p.m.

Employers	Base case	0.0	69.6	495.2	2275.5	2525.6	1956.8
95%CI	Lower bound	0.0	69.6	494.3	2266.3	2500.7	1911.5
	Upper bound	0.0	69.7	495.8	2282.6	2539.9	1978.9
Others in society	Base case	0.0	1.1	8.1	38.2	43.7	35.5
95%CI	Lower bound	0.0	1.1	8.1	38.2	43.6	35.5
	Upper bound	0.0	1.1	8.2	38.3	43.8	35.6
Health care	Base case	0.0	3.2	23.7	124.6	124.6	38.2
95%CI	Lower bound	0.0	3.2	23.7	123.9	118.3	19.7
	Upper bound	0.0	3.2	23.8	129.2	141.9	63.3
Public authority	Base case (Fixed)	0.0	0.0	0.0	0.0	0.0	0.0
Taxes and duties	Base case	0.0	-34.6	-246.9	-1148.1	-1307.4	-1062.6
95%CI	Lower bound	0.0	-34.6	-247.0	-1149.1	-1309.1	-1068.3
	Upper bound	0.0	-34.6	-246.9	-1146.7	-1303.7	-1058.0
Total	Base case	0.0	-0.6	-0.6	132.3	434.6	643.5
95%CI	Lower bound	0.0	-0.7	-1.0	128.6	423.7	621.1
	Upper bound	0.0	-0.6	-0.1	138.9	454.9	677.2

6.2 No one starts smoking in the future

6.2.1 Methods

The scenario in which no one starts smoking in the future is calculated by manually setting the transition 'start' to zero from 2017 onwards. The other transitions (stop and relapse) are not changed and therefore, similar to the reference scenario.

6.2.2 Smoking prevalence

If from 2017 onwards, no one would start smoking, smoking prevalence is projected to decrease from 19.8% from 2015, to 19.6% by 2017, to 17.6% by 2020, to 12.0% by 2030, to 7.8% by 2040 and to 4.8 by 2050 (See Table 6.14 for gender specific smoking prevalence). The other transitions (stop and relapse) remain the same as projected in the reference scenario.

Table 6.14 Scenario No one starts smoking: Gender specific smoking prevalence projections

	2015	2017	2020	2030	2040	2050
Male smokers	21.9%	21.6%	19.3%	12.9%	8.2%	4.9%
Female smokers	17.8%	17.6%	15.9%	11.0%	7.4%	4.7%
All smokers	19.8%	19.6%	17.6%	12.0%	7.8%	4.8%
Male ex-smokers	28.9%	28.7%	28.3%	25.5%	20.9%	15.9%
Female ex-smokers	29.0%	28.9%	28.5%	26.0%	21.4%	16.0%
All ex-smokers	28.9%	28.8%	28.4%	25.8%	21.2%	15.9%
Male never smokers	49.2%	49.7%	52.4%	61.6%	70.9%	79.3%
Female never smokers	53.2%	53.5%	55.5%	62.9%	71.2%	79.3%
All never smokers	51.2%	51.6%	54.0%	62.3%	71.0%	79.3%

6.2.3 Health care impact

A decrease in smoking prevalence leads to a change in smoking attributable diseases.

Table 6.15 presents the prevalence of smoking-related disease in the population when no one starts smoking from 2017 onwards, the health care costs and the smoking related mortality.

Table 6.15 Scenario No one starts smoking: Prevalence* of smoking-related diseases

Chronic diseases	2015	2017	2020	2030	2040	2050
Lung cancer	0.22%	0.22%	0.23%	0.25%	0.22%	0.19%
Stomach cancer	0.04%	0.04%	0.04%	0.04%	0.05%	0.05%
Oesophagus cancer	0.05%	0.05%	0.05%	0.06%	0.06%	0.05%
Larynx cancer	0.05%	0.05%	0.05%	0.05%	0.04%	0.04%
Bladder cancer	0.12%	0.12%	0.13%	0.15%	0.16%	0.15%
Kidney cancer	0.12%	0.12%	0.12%	0.13%	0.13%	0.13%
Pancreas cancer	0.02%	0.02%	0.02%	0.03%	0.03%	0.03%
Oral cavity cancer	0.03%	0.03%	0.03%	0.03%	0.02%	0.02%
Myocardial infarction	4.01%	4.10%	4.23%	4.54%	4.56%	4.36%
Congestive heart failure	0.92%	0.96%	1.02%	1.24%	1.38%	1.42%
Stroke	1.37%	1.44%	1.54%	1.79%	1.87%	1.82%
COPD	2.55%	2.66%	2.82%	3.12%	3.01%	2.73%
Diabetes	5.50%	5.66%	5.87%	6.38%	6.55%	6.50%

* the prevalence refers to the total prevalence, attributable and non-attributable to smoking

Table 6.16 Scenario No one starts smoking: Health care costs in absolute numbers per year (Million Euros) and the number of smoking-related deaths

	2015	2017	2020	2030	2040	2050
Smoking-related diseases	8347	8230	8011	6849	5244	3755
Other diseases	90501	87578	83150	68363	53191	39787
Smoking-related deaths	14509	15928	17348	16913	7223	-3722*

* Negative value because if people would never have smoked, they would have lived longer and would die later. Hence, the number of deaths in 2050 would be higher compared to a situation with smoking.

Other smoking-attributable diseases

Table 6.17 and 6.18 present the smoking number of patients and smoking-attributable health care costs for Alzheimer and eye diseases.

Table 6.17 Scenario No one starts smoking: Number of Alzheimer patients and smoking-attributable health care costs per year (million €))

	2015	2017	2020	2030	2040	2050
Non-smoking Alzheimer patients	46814	49787	54309	70811	81719	86007
Smoking Alzheimer patients	10584	10841	10707	10280	8854	6697
Attributable to smoking	6304	6280	5709	3966	2590	1574
Attributable to other factors	4279	4561	4998	6314	6263	5123
Non-smoking Alzheimer costs	€ 2.013	€ 2.018	€ 2.015	€ 1.954	€ 1.678	€ 1.314
Smoking Alzheimer costs	€ 455	€ 439	€ 397	€ 284	€ 182	€ 102
Attributable to smoking	€ 271	€ 255	€ 212	€ 109	€ 53	€ 24
Attributable to other factors	€ 184	€ 185	€ 185	€ 174	€ 129	€ 78

Table 6.18 Scenario No one starts smoking: Number of eye disease patients and smoking-attributable health care costs per year (million €)

	2015	2017	2020	2030	2040	2050
Non-smoking eye disease patients	57576	60958	65950	82358	91862	93296
Smoking eye disease patients	17967	18281	18623	18609	16591	13531
Attributable to smoking	11395	11352	11206	10213	8924	7560
Attributable to other factors	6571	6929	7417	8397	7667	5971
Non-smoking eye disease costs	€ 393	€ 392	€ 388	€ 360	€ 299	€ 226
Smoking eye disease costs	€ 120	€ 115	€ 107	€ 80	€ 53	€ 32
Attributable to smoking	€75	€70	€59	€30	€15	€7
Attributable to other factors	€ 45	€ 45	€ 44	€ 37	€ 25	€ 14

6.2.4 Consumer surplus

Table 6.19 Scenario No one starts smoking: Incremental effects on consumer surplus per year in million Euros

	2015	2017	2020	2030	2040	2050
Consumer surplus	0.0	0.0	-308.6	-893.4	-1061.1	-1021.2

6.2.5 Quality adjusted life years

Table 6.20 Scenario No one starts smoking: QALYs and their monetary value per year in billion Euros

	2015	2017	2020	2030	2040	2050
Number QALYs	13910896	13971734	14045629	14162576	14125878	14048382
Value €50,000	696	658	606	455	337	250
Value €100,000	1391	1317	1212	909	675	499

6.2.6 Productivity

Estimates of the total productivity transfers for the 'no one starts smoking' scenario can be found in table 6.21.

Table 6.21 Scenario No one starts smoking: Production losses per year in million euros

	2015	2017	2020	2030	2040	2050
Direct methods						
Absenteeism and presenteeism	7515	7057	5871	3035	1475	667
Productivity transfers	186484	176677	162452	120296	88689	66287
(Old age-) pensions	41208	41120	40230	35581	28390	20173
Indirect method						
Absenteeism and presenteeism	5598	5272	4827	3545	2777	2160
Total production losses	240805	230126	213380	162456	121330	89287

6.2.7 Government

Within the smoke-free scenario 'no one starts smoking', the government income based on excise tax is based on the projections of the proportional decline in prevalence smokers in future years. The assumption is made that prices and taxes for tobacco remain constant over the years. In this scenarios, the government incomes will decrease in future years from €3452 million in 2015 to €856 million by 2050 in the smoke-free 'no one starts smoking' (see Table 6.22).

Table 6.22 Scenario No one starts smoking: Future government income due to excise tax on tobacco products per year in million Euros

	2015	2017	2020	2030	2040	2050
Excise tax	2632	2471	2056	1063	516	234
Total incl. correction factor	3737	3509	2920	1509	733	332

6.2.8 Others in society

Fire damages

The effects of the smoke-free scenarios via no one starts smoking from 2017 onwards on total fire damages insurance claims are described below.

Table 6.23 Scenario No one starts smoking: Total costs indoor fires due to smoking per year in million Euros

	2015	2017	2020	2030	2040	2050
Total costs	60	57	47	24	12	5

Passive smoking & smoking during pregnancy

Effects on passive smoking & smoking during pregnancy are not estimated nor monetarised in this SCBA report.

Environment

The effects of the smoke-free scenarios via no one starts smoking from 2017 onwards on environmental costs insurance claims are described below.

Table 6.24 Scenario No one starts smoking: Total costs environment per year in million Euros

	2015	2017	2020	2030	2040	2050
Total costs	63	59	49	25	12	6

6.2.9 Intervention costs

Not applicable as this scenario is only meant to show the effects of nobody starting to smoke in 2017.

6.2.10 Net present value

An overview of costs and benefits to society are presented in Table 6.25 and Table 6.26 for the scenario smoke-free Netherlands, in which no one starts smoking from 2017 onwards, compared

with the reference scenario. All costs are presented in Million Euros, indexed to 2015 and discounted with 3%.

Table 6.25 Net present value: Total reference scenario costs and increments of Scenario No one starts smoking vs. reference scenario per year in million euros

		2030		2040		2050	
		Total	Incr.	Total	Incr.	Total	Incr.
Consumers	Value of total QALYs (€50.000)	454521	226.6	337330	602.1	249628	1010.9
	Value of consumer surplus	*	-893.4	*	-1061.1	*	-1021.2
Producers	Producer surplus	P.m.	P.m.	P.m.	P.m.	P.m.	P.m.
Employers	Absenteeism and presenteeism	3035	-1555.9	1475	-1847.9	667	-1778.4
	Absenteeism due to chronic diseases	3545	72.9	2777	143.8	2160	247.0
Others in society	Fire damage costs	24	-12.5	12	-14.8	5	-14.3
	Environmental costs	25	-13.0	12	-15.5	6	-14.9
Health care	Smoking related health care costs	6849	-37.3	5244	-82.8	3755	-124.0
	Other diseases health care costs	68363	17.1	53191	79.5	39787	187.8
	Smoking related Alzheimer costs	109	-56.1	53	-66.7	24	-64.2
	Smoking related eye disease costs	30	-15.5	15	-18.4	7	-17.7
Public Authority	Intervention costs	0	0.0	0	0.0	0	0.0
	Enforcement costs	P.m.	P.m.	P.m.	P.m.	P.m.	P.m.
Taxes and duties	Government income	1509	-773.8	733	-919.0	332	-884.4
	(Old-age-) pensions transfers	35581	10.7	28390	61.8	20173	130.4
	Productivity transfers	120296	31.9	88689	88.8	66287	156.1

* Only estimated as incremental effect

Table 6.26 Overview of social costs and benefits: Scenario No one starts smoking vs. Reference scenario per year in million euros

		2015	**2017**	**2020**	**2030**	**2040**	**2050**
Consumers	Value of gained total QALYs (€50.000)	0.0	0.0	9.5	226.6	602.1	1010.9
	Value of consumer surplus	0.0	0.0	-308.6	-893.4	-1061.1	-1021.2
Producers	Producer surplus	P.m.	P.m.	P.m.	P.m.	P.m.	P.m.
Employers	Savings absenteeism and presenteeism	0.0	0.0	537.5	1555.9	1847.9	1778.4
	Savings absenteeism due to chronic diseases	0.0	0.0	-4.2	-72.9	-143.8	-247.0
Others in society	Savings fire damage	0.0	0.0	4.3	12.5	14.8	14.3
	Savings environment	0.0	0.0	4.5	13.0	15.5	14.9
Health care	Savings smoking related health care costs	0.0	0.0	2.1	37.3	82.8	124.0
	Savings other diseases health care costs	0.0	0.0	-0.3	-17.1	-79.5	-187.8
	Savings smoking related Alzheimer costs	0.0	0.0	19.4	56.1	66.7	64.2
	Savings smoking related eye disease costs	0.0	0.0	5.4	15.5	18.4	17.7
Public Authority	Intervention costs	0.0	0.0	0.0	0.0	0.0	0.0
	Enforcement costs	P.m.	P.m.	P.m.	P.m.	P.m.	P.m.

Taxes and duties	Gained government income	0.0	0.0	-267.3	-773.8	-919.0	-884.4
	Savings (old-age-) pensions	0.0	0.0	-0.1	-10.7	-61.8	-130.4
	Gained productivity transfers	0.0	0.0	1.0	31.9	88.8	156.1
Total		0.0	0.0	3.1	180.9	471.8	709.6

**Negative values (savings) represent extra costs compared to the reference scenario*

6.2.11 Cumulative net present value

The cumulative costs and benefits for the scenario no one starts smoking are provided in table 6.26.

Table 6.26 Cumulative social costs and benefits: Scenario No one starts smoking vs. Reference scenario – in million euros

		2020	2030	2040	2050
Consumers	Value of total QALYs (€50.000)	13	1097	5364	13627
	Value of consumer surplus	-639	-7409	-17496	-28009
Producers	Producer surplus	p.m.	p.m.	p.m.	p.m.
Employers	Absenteeism and presenteeism	1113	12902	30470	48780
	Absenteeism due to chronic diseases	-6	-392	-1511	-3476
Others in society	Fire damage costs	9	103	244	391
	Environmental costs	9	108	255	408
Healthcare	Smoking related health care costs	3	194	821	1875
	Other diseases health care costs	0	-69	-537	-1910
	Smoking related Alzheimer costs	40	465	1099	1760
	Smoking related eye disease costs	11	129	304	487
Public Authority (Government)	Intervention costs	0	0	0	0
	Enforcement costs	p.m.	p.m.	p.m.	p.m.
Taxes and duties	Government income	-554	-6417	-15154	-24260
	(Old-age-) pensions transfers	0	-38	-390	-1393
	Productivity transfers	1	147	767	2022
Total		1	822	4237	10304

**Negative values (savings) represent extra costs compared to the reference scenario*

6.2.12 Sensitivity analyses

The results of the probabilistic sensitivity analysis are provided below. The results of the one-way sensitivity analyses (i.e. different WTP values for QALYs and the in-/exclusion of the consumer surplus) can be found in Chapter 7.5.

Probabilistic sensitivity analyses

Table 6.27 Confidence intervals (CI) for the incremental costs of scenario no one starts smoking in the future vs. Reference scenario based on PSA per year (in millions)

		2015	2017	2020	2030	2040	2050
Consumers	Base case	0.0	0.0	-299.1	-666.8	-459.0	-10.3
95%CI	Lower bound	0.0	0.0	-299.6	-677.2	-484.0	-49.1
	Upper bound	0.0	0.0	-298.2	-648.6	-407.1	80.1
Producers	Base case (Fixed)	P.m.	P.m.	P.m.	P.m.	P.m.	P.m.
Employers	Base case	0.0	0.0	533.2	1483.0	1704.1	1531.4
95%CI	Lower bound	0.0	0.0	532.6	1468.8	1664.3	1463.4
	Upper bound	0.0	0.0	533.5	1489.7	1720.2	1558.2
Others in society	Base case	0.0	0.0	8.8	25.5	30.3	29.1
95%CI	Lower bound	0.0	0.0	8.8	25.5	30.3	29.1
	Upper bound	0.0	0.0	8.8	25.5	30.3	29.2
Health care	Base case	0.0	0.0	26.6	91.8	88.4	18.1
95%CI	Lower bound	0.0	0.0	26.5	90.3	82.0	0.0
	Upper bound	0.0	0.0	26.9	98.0	103.7	42.8
Public authority	Base case (Fixed)	0.0	0.0	0.0	0.0	0.0	0.0
Taxes and duties	Base case	0.0	0.0	-266.4	-752.7	-892.0	-858.7
95%CI	Lower bound	0.0	0.0	-266.8	-753.9	-894.6	-864.6
	Upper bound	0.0	0.0	-266.0	-751.3	-889.7	-854.8
Total	Base case	0.0	0.0	3.1	180.9	471.8	709.6
95%CI	Lower bound	0.0	0.0	2.6	175.8	458.8	681.9
	Upper bound	0.0	0.0	4.0	191.5	500.7	758.4

7. Part IV: Overview of net present value per scenario

Chapter 7 provides an overview and comparison of the smoking prevalence and the net present value of all scenarios examined in this report compared to the reference scenario. An overview of the structure of Chapter 7 can be found in Figure 7.1.

Figure 7.1 Overview chapter 7

7.1	Smoking prevalence per scenario	
7.2	Social effects per scenario	
	7.2.1	Value of gained total QALYs (€50.000) per scenario
	7.2.2	Value of consumer surplus per scenario
7.3	Financial effects per scenario	
7.4	Total costs per scenario	
	7.4.1	Total costs per scenario per year
	7.4.2	Cumulative costs and benefits per scenario
7.5	Total costs for stochastic sensitivity analyses	
	7.5.1	Value of the QALY
	7.5.2	Exclusion of the consumer surplus
	7.5.3	Comparison of MMC (low, normal, high impact scenario's)

Regarding the net present values discussed in this chapter, positive values mean a benefit to society compared to the reference scenario and negative values mean a cost to society compared to the reference scenario. All costs are presented in million Euros, indexed to 2015 and discounted at 3%.

7.1 Smoking prevalence per scenario

Table 7.1 presents an overview of the prevalence of smoking per scenario. In addition, figure 1, presents a graphical presentation of the smoking prevalence per year.

Figure 7.1 Graphical presentation of the smoking prevalence per scenario

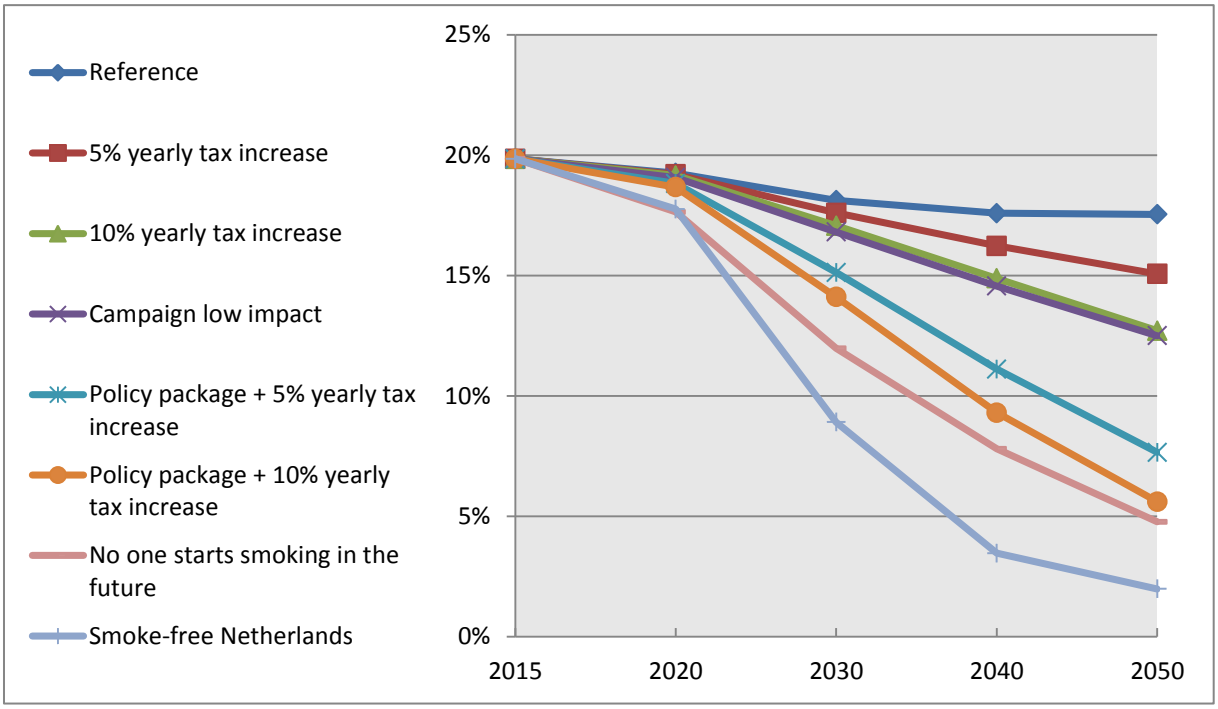

Table 7.1 Overview of the smoking prevalence per scenario

Scenarios	2015	2017	2020	2030	2040	2050
Reference	19.8%	19.6%	19.3%	18.1%	17.6%	17.5%
5% yearly tax increase	19.8%	19.6%	19.2%	17.6%	16.2%	15.1%
10% yearly tax increase	19.8%	19.6%	19.2%	17.1%	14.9%	12.7%
Campaign low impact	19.8%	19.6%	19.1%	16.8%	14.6%	12.5%
Policy package + 5% yearly tax increase	19.8%	19.6%	18.8%	15.1%	11.1%	7.7%
Policy package + 10% yearly tax increase	19.8%	19.5%	18.7%	14.1%	9.3%	5.6%
Smoke-free Netherlands	19.8%	19.4%	17.8%	8.9%	3.5%	2.0%
No one starts smoking in the future	19.8%	19.6%	17.6%	12.0%	7.8%	4.8%

7.2 Social effects

In this chapter, social effects are referred to be values which are derived from non-monetary units. More specifically, these costs as derived from QALYs gained or from consumer surplus valued by estimated WTP (e.g. €50.000 for one QALY). Hence, these costs are fundamentally different from financial effects such as excise tax or health care costs as those are (more or less) based on real costs. In addition, these costs will not directly lead to "hard" monetary profits but have an important role on the overall welfare in society. For this reason, the value of total QALYs gained and the value of the

consumer surplus have been separated to give more insight in these costs. In section 7.3 a comparison will be made between all scenarios based on the total costs (social and financial effects).

7.2.1 Value of gained total QALYs (€50.000)

In Table 7.2 an overview of the net present value of gained total QALYs (€50.000) is presented per scenario. As is shown in the table, the scenario in which no one starts to smoke from 2017 onwards will result in the largest benefit (€1010.9 million). An increase of excise tax of 5% will result in the lowest benefit (€121.6 million).

Table 7.2 Overview of the net present value of gained total QALYs (€50.000) per scenario per year in million euros

Scenarios	2030	2040	2050
5% yearly tax increase	10.5	51.1	121.6
10% yearly tax increase	20.9	100.9	237.6
Campaign low impact	29.9	126.0	275.6
Policy package + 5% yearly tax increase	66.7	269.9	562.5
Policy package + 10% yearly tax increase	87.8	345.0	694.5
Smoke-free Netherlands	181.9	579.3	920.7
No one starts smoking in the future	226.6	602.1	1010.9

7.2.2 Value of consumer surplus

In table 7.3 an overview of the net present value of the consumer surplus is presented per scenario. As shown below, the scenario in which the excise tax is increase with 10% per year results in the largest reduction in consumer surplus (-€-13,009 million). The mass media campaign scenario will result in the lowest reduction of consumer surplus (-€402.9 million).

Table 7.3 Overview of the net present value of the consumer surplus per scenario per year in million euros

Scenarios	2030	2040	2050
5% yearly tax increase	-1009.3	-1618.1	-2200.8
10% yearly tax increase	-3223.6	-6866.0	-13009.0
Campaign low impact	-190.7	-327.9	-402.9
Policy package + 5% yearly tax increase	-939.4	-1373.3	-1700.9
Policy package + 10% yearly tax increase	-2953.0	-5687.6	-9957.9
Smoke-free Netherlands	-1339.9	-1531.3	-1245.2
No one starts smoking in the future	-893.4	-1061.1	-1021.2

7.3 Financial effects

All costs that are based on real costs (e.g. health care costs) or considered to be measurable in monetary terms, are considered financial effects. An overview of the net present value of the financial effects, which are all costs previously reported in this report excluding the value of the QALYs and the consumer surplus, are presented in table 7.4.

Table 7.4 Overview of the net present value of the financial effects per scenario per year in million euros

Scenarios	2030	2040	2050
5% yearly tax increase	2465.5	3773.5	4881.3
10% yearly tax increase	6979.0	14018.1	24200.0
Campaign low impact	179.1	294.9	320.9
Policy package + 5% yearly tax increase	2470.9	3126.0	3022.8
Policy package + 10% yearly tax increase	6205.3	9411.8	11297.3
Smoke-free Netherlands	1290.3	1385.9	967.7
No one starts smoking in the future	847.7	930.8	719.6

7.4 Total costs per scenario

7.4.1. Total costs per scenario per year

In table 7.5 an overview is presented of the net present value per scenario per year. These costs include all social and financial effects per scenario.

Table 7.5 Overview of the net present value per scenario per year in million euros

Scenarios	2030	2040	2050
5% yearly tax increase	1247.2	1961.1	2527.7
10% yearly tax increase	3776.3	7253.0	11428.7
Campaign low impact	18.4	93.0	193.6
Policy package + 5% yearly tax increase	1409.6	1854.7	1744.9
Policy package + 10% yearly tax increase	3340.1	4069.3	2034.0
Smoke-free Netherlands	132.3	434.6	643.5
No one starts smoking in the future	180.9	471.8	709.6

7.4.2 Cumulative costs and benefits per scenario

In table 7.6 an overview is presented of the total cumulative costs and benefits per scenario. These cumulative costs include all social and financial effects per scenario.

Figure 7.2 Graphical presentation of the (incremental) cumulative net present value per scenario per year compared to the reference scenario in million euros

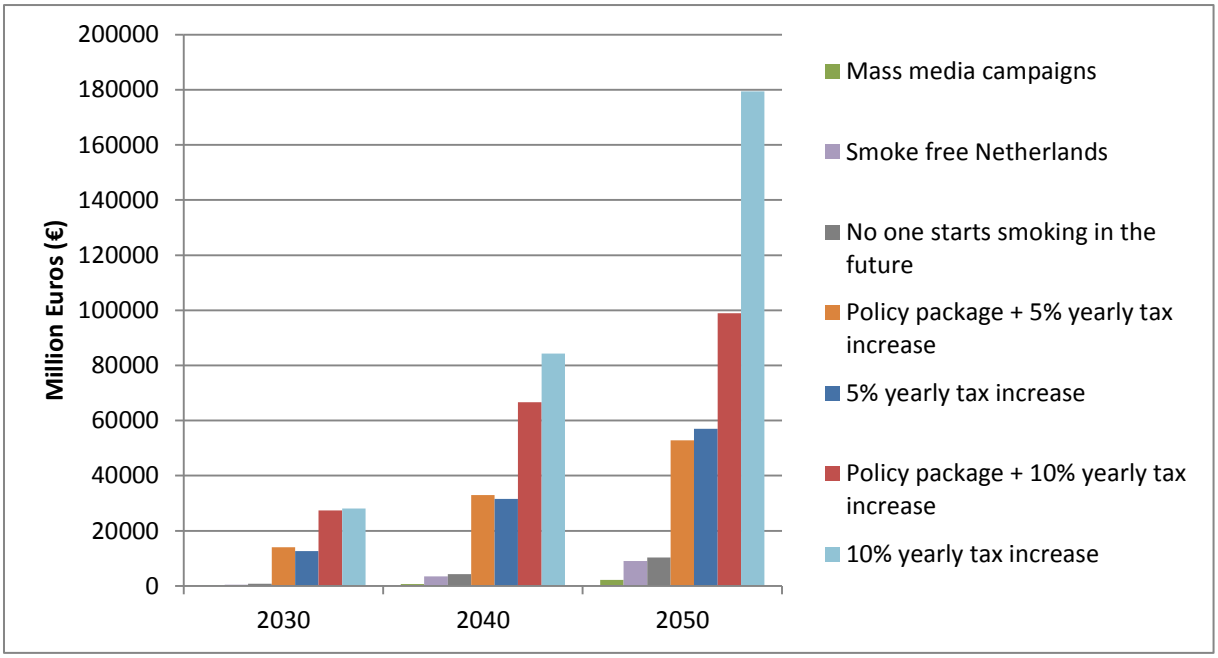

Table 7.6 Overview of the cumulative net present value per scenario in million euros

Scenarios	2030	2040	2050
5% yearly tax increase	12,672	31,524	56,999
10% yearly tax increase	28,088	84,296	179,402
Campaign low impact	129	734	2234
Policy package + 5% yearly tax increase	14,085	32,946	52,850
Policy package + 10% yearly tax increase	27,356	66,598	98,892
Smoke-free Netherlands	506	3478	9090
No one starts smoking in the future	822	4237	10,304

7.5 Total costs for stochastic sensitivity analyses

To give an overview of the implications of several assumptions (e.g. the value of the QALY), different overview tables will be presented.

7.5.1 Value of the QALY

In table 7.7 an overview is presented of the net present value per scenario if one QALY would be valued with €100,000 instead of €50,000.

Table 7.7 Overview of the net present value per scenario per year when 1 QALY = €100,000; in million euros

Scenarios	2030	2040	2050
5% yearly tax increase	1257.7	2012.2	2649.2
10% yearly tax increase	3797.2	7353.9	11666.4
Campaign low impact	48.3	219.0	469.2
Policy package + 5% yearly tax increase	1476.3	2124.6	2307.4
Policy package + 10% yearly tax increase	3427.8	4414.3	2728.5
Smoke-free Netherlands	314.9	1014.6	1564.9
No one starts smoking in the future	407.9	1074.4	1721.0

In table 7.8 an overview is presented of the net present value per scenario if one QALY would be valued with €20,000 instead of €50,000.

Table 7.8 Overview of the net present value per scenario per year when 1 QALY = €20,000; in million euros

Scenarios	2030	2040	2050
5% yearly tax increase	1240.9	1930.5	2454.7
10% yearly tax increase	3763.7	7192.5	11286.2
Campaign low impact	0.4	17.5	28.3
Policy package + 5% yearly tax increase	1369.5	1692.8	1407.4
Policy package + 10% yearly tax increase	3287.4	3862.3	1617.3
Smoke-free Netherlands	23.1	87.0	91.1
No one starts smoking in the future	44.9	110.6	103.1

In table 7.9 an overview is presented of the net present value per scenario if one QALY would be valued with €200,000 instead of €50,000.

Table 7.9 Overview of the net present value per scenario per year when 1 QALY = €200,000; in million euros

Scenarios	2030	2040	2050
5% yearly tax increase	1278.8	2114.4	2892.4
10% yearly tax increase	3839.0	7555.7	12141.6
Campaign low impact	108.2	471.0	1020.3
Policy package + 5% yearly tax increase	1609.8	2664.3	3432.3
Policy package + 10% yearly tax increase	3603.4	5104.4	4117.5
Smoke-free Netherlands	678.1	2172.6	3405.7
No one starts smoking in the future	860.7	2278.1	3742.3

7.5.2 Exclusion of the consumer surplus

The inclusion of the consumer surplus in the model can be debated upon, as consumer surplus is a difficult concept to interpret within the context of an addiction-related substance such as tobacco. Because of the addictive nature of tobacco, one may ask the question whether it is a purely voluntary decision to buy cigarettes. Hence, to take this perspective into account table 7.10 presents an overview of the discussed scenarios excluding the consumer surplus.

Table 7.10 Overview of the net present value per scenario per year excluding the consumer surplus in million euros

Scenarios	2030	2040	2050
5% yearly tax increase	2256.5	3579.2	4728.5
10% yearly tax increase	6999.9	14119.0	24437.7
Campaign low impact	209.1	420.9	596.5
Policy package + 5% yearly tax increase	2349.0	3228.0	3445.8
Policy package + 10% yearly tax increase	6293.1	9756.9	11991.9
Smoke-free Netherlands	1472.2	1965.9	1888.7
No one starts smoking in the future	1074.3	1532.9	1730.8

7.5.3. Comparison of MMC (low, normal, high impact scenario's)

As presented in Chapter 4.2, there is a range around the likely effect of MMCs. Hence, table 7.11 presents an overview of the net present values of the scenario's in which the minimal and maximum expectable effect size are calculated.

Table 7.11 Overview of the net present value per scenario per year comparing three MMC scenarios in million euros

Scenarios	2030	2040	2050
Campaign low impact (relative decrease of 1,2% per year)	18.4	93.0	193.6
Campaign normal impact (relative decrease of 3,55% per year)	66.5	273.8	528.8
Campaign high impact (relative decrease of 6,5% per year)	142.9	445.2	613.5

8. Discussion

This chapter describes the general conclusions that can be drawn from this report, highlights methodological considerations and discuss policy implications.

8.1 General conclusions

The aim of this study was to provide insights into all of the social costs and benefits related to smoking and to examine the impact of several governmental policies to limit the use of tobacco on the societal costs and benefits.

The reference scenario, the situation in which the current situation is modelled without changing existing policies, so without additional/future governmental policies, shows that the prevalence of smoking is expected to decrease by 2.3 percentage points in the coming 35 years. However, active governmental involvement could potentially reduce the prevalence of smoking by more than 14 percentage points depending on the chosen policy package. In addition, these policies not only influence smoking prevalence but also influence other domains such as quality of life, productivity losses and revenues from taxation for the government. Depending on the nature of the chosen policies, different stakeholders are impacted. An increase in the excise tax of 5% or 10% per year, for example, mainly (positively) impacts the government income from taxes but also decreases the overall prevalence of smoking in 2050. A raise in excise tax could potentially lead to an incremental net benefit of €11,429 million per year. Besides tax increases, mass media campaigns can have a strong effect on the prevalence of smoking. In addition, the additional intervention costs are easily outweighed by the extra benefits in terms of gains in other domains, e.g. QALY gains or savings in the costs associated with productivity in both absenteeism and presentism. A combination of these effects can be found in the two scenarios in which the World Health Organization's MPOWER policy package is combined with excise tax increases. Scenarios which combine the MPOWER policy package with increases in excise tax result in a large decrease in the prevalence of smoking (up to 14.2 percentage points) as well as a large increase in monetary benefits (net present value of €2,034 million compared to the reference scenario). When looking at the cumulative net benefits, the same conclusion can be drawn, though, the benefits are even more enlarged as the benefits per year are being added.

Besides policy-based scenarios, this study examined several hypothetical scenarios. One scenario was reversed-engineered from a prevalence of smoking of <5% in 2050 and estimated the societal costs and benefits attributable to this desired end-point. In the other scenario it was assumed that no one would start smoking from 2017 onwards. These scenarios demonstrate the large increase in monetary gains related with a decrease in smoking prevalence. Without specific interventions aimed

at tobacco control, such as the latter two scenarios, we assume that a gradual denormalization of smoking within the society contributed to the effects.

Looking at the two categories of social effects, i.e. value of gained QALYs and the consumer surplus, it can be seen that all scenarios result in a positive net benefit in terms of the value of QALYs gain but a negative net benefit in terms of consumer surplus. The QALY gain can be explained by the fact that as the prevalence of smoking drops, smoking-related morbidity and mortality will decrease within society. Hence, on average, the quality of life and life expectancy will increase within society. The decrease of the consumer surplus is mainly explained by one or two factors depending on the scenario. Firstly, a decrease in the prevalence of smoking observed in all scenarios will cause the consumer surplus to decrease as the amount of consumer surplus is directly related to the prevalence of smoking. Secondly, in scenarios in which there is an increase in the excise tax, the cost of cigarettes per package will increase over time and hence the difference between the consumer willingness to pay (WTP) and the market price will decline gradually. When considering financial effects, it is important to focus on the relationship between the nature of the policy intervention and the specific domains. For example, when a scenario does not heavily impact the prevalence of smoking (relative to the other scenarios), such as the scenarios with only excise tax increases, less benefits can be expected in smoking-related health care costs. However, doing so will cause the government incomes from taxes to raise high above the other scenarios. For scenarios that result in a large decrease in the prevalence of smoking, smoking-related health care costs will decrease due to the lower number of smokers. Due to this low number of smokers, less people will pay excise taxes. Consequently, government incomes from taxes will be influenced negatively. In the combined scenarios (MPOWER policy package plus excise tax increase), both a strong decrease in the prevalence of smoking and an increase in tax incomes occurs. Moreover, one should be aware that increases in government incomes from taxes are essentially transfer costs (from consumers/producers to the government) whereas a decrease in the prevalence of smoking, resulting in an increase in QALYs or reduction of smoking-attributable health care costs, is beneficial to society as a whole.

Lastly, it is important to distinguish social effects (consumer surplus and QALYs) from financial effects in the outcomes of this study. The social effects are highly dependent on the WTP for such an effect. As demonstrated with the sensitivity analyses regarding the value of a QALY, scenario's which mainly affect the prevalence of smoking are highly impacted by the WTP for a QALY. In this report, we have chosen to present base-case estimates with a QALY value of €50,000, which is the lowest of the two recommended values given in the SCBA instructions [18]. On the other hand, mainly in scenarios involving excise tax increase, the in-or exclusion of the consumer surplus causes significant

differences. Although the inclusion of the consumer surplus is debated because of the addictive nature of smoking, we have included the consumer surplus in the base case analyses throughout this report in order to obtain the most conservative estimates and to stay in line with the SCBA guidelines.

8.2 Methodological considerations

This study is one of the first SCBA within the public health care sector in the Netherlands. Moreover, it is one of the first studies following the SCBA guidelines for health care related policies developed by the RIVM. Efforts have been made to present all results as transperant as possible. Furthermore, we have tried to use conservative parameter estimates on prevalence-elasticity (using -0.2 instead of -0.4), impact of massa media campaigns (using the lower bound of the effectiveness estimate), and to present all base case analyses with a QALY value of €50,000 (instead of €100,000). Taking the consumer surplus into account, further contributed to presenting the most conservative estimates.

Several models were needed to be combined in order to answer all relevant research questions, whereas one overall model would have been preferred in terms of complexity, transparency and consistency. In developing and combining the models used in this study, several assumptions and choices have been made which each have their impact on the results.

The inclusion of the consumer surplus in the model is a complex procedure. In general, the consumer surplus is the extra surplus consumers gain when buying a good or service. This surplus is based on the difference between the maximum willingness to pay (WTP; e.g. the situation in which everybody will stop buying cigarettes) and the actual price of a good. However, the actual consumer surplus for consumption is difficult to measure as it is unknown what the WTP of the last consumer of cigarettes would be. In this study the consumer surplus was estimated based on a linear price elasticity of -0.4, resulting in €5.04 per package of cigarettes and a maximum WTP of €21.70 (see Chapter 3.3). However, when the excise taxes increase per year, the price elasticity decreases over time (e.g. at a price level of €23.95 the prevalence of smoking is still 15.1%) which leads to a theoretically increased WTP per smoker over time. Thus, one can argue that, given the results obtained from the increase tax scenarios, the consumer surplus in the reference scenario is underestimated compared to a situation with increases in excise tax.

Social economic status (SES) is not included in the version of the CDM that was applied. Hence, SES could not be incorporated in this study. However, from previous studies it is clear that smoking is more prevalent among people with a lower SES, that their quit attempts are less likely to be

successful, less sensitive to MMC, and that they often have a stronger addiction to tobacco [125]. Including SES in the model could have influenced the results, especially for people with a low SES. As people with a low SES are more often heavy smokers and less sensitive to MMC, the scenarios presented in this study are likely to overestimate the benefits for this specific subpopulation. On average, this effect may be offset by a higher than assumed effectiveness among people with a high SES. However, one should be aware of negative equity effects. More research is needed to examine equity issues, especially in health outcomes, regarding smoking cessation programs in people with a low SES.

Following the SCBA instructions, we have calculated productivity losses based on the total labour force in the Netherlands, transfer costs and gross (average) wages, levels of absenteeism and premature mortality due to smoking, and smoking prevalence in the Netherlands. However, within health care research, especially in the field of health economic evaluations, reference prices are recommended in the Dutch guidelines for pharmacoeconomic research [126].

We have not directly taken into account the eventuality that the impact of new policies is likely to decay over time. These so-called decay effects were not directly included in the model. However, whenever relevant, the intervention costs were estimated based on a 3-year cycle (and associated with higher costs in every first year) in order to avoid campaign-tiredness of the population.

Related to the price elasticity, we assumed that the effect of tax increase is stable over time. One could argue that an increase of excise tax every five year (in “chunks”) instead of yearly tax increase would result in a larger decrease in the prevalence of smoking (assuming the same increase in price but only a difference in timing).

Furthermore, an increase of excise tax of 5% or 10% may sound unrealistically high to some, as one package of cigarettes would cost €23.95 (in 5% tax scenario) or €108.6 (in 10% tax increase scenario). €23.95 (in the 5% tax increase scenario) can certainly be considered very realistic. For example, Australia will raise the price per package cigarettes to €29 already in 2017. As these prices are not corrected for inflation, prices might just as well increase to levels at or around €108.6 over a period of 35 years.

Lastly, the so-called pro memory posts (i.e. posts that cannot be meaningfully measured or estimated or converted into monetary terms) benefits and costs were not monetarised or were not covered in much detail. Within the health care sector or in the society as a whole, more actors are active

besides the government in different domains and may have different interests. Hence, the result of smoking cessation is likely to impact multiple actors in different ways. For example, in paragraph 3.7 it is highlighted that a reduction of smoking is likely to (negatively) impact the producer surplus. In addition, one should be aware of PM costs in the labour market, e.g., vendors or shop owners solely focusing on the sale of tobacco products in the Netherlands (i.e., a decline in tobacco demand will lead to a shift in the supply of (other) goods).

8.3 Policy implications

Given the results of this study it can be concluded that in all policy scenarios the net costs are lower than the net benefits. Hence, in all policy scenarios, the Dutch society is better off than in the reference scenario. In addition, all scenarios discussed in this study will result in reductions of the prevalence of smoking. Furthermore, intervention costs (e.g. MMC) are easily offset by long-term net gains. Structural investments in smoking cessation by the government could be compensated by increase incomes from excise tax.

This study further demonstrated that reducing the prevalence of smoking has beneficial effects for various stakeholders within the Dutch society: such as employers (e.g. increased productivity) and consumers (e.g. increase quality of life). It also benefits the governmental incomes from tax. However, if one is interested in a more detailed insight of the costs and benefits associated with smoking for specific stakeholders within society, a more detailed study would be required that takes into account a more detailed view on the costs and benefits associated relevant to these stakeholders (e.g. less aggregated).

When looking at increases in excise taxes, one should be aware of possible border effects. An increase in excise taxes in the long-term will be more politically viable if taxes in surrounding countries increase as well. This highlights the need for further international (EU wide) agreement on tobacco taxation policy. Furthermore, in this study, we assumed that the producers of cigarettes keep their prices stable. In reality, it might be the case that producers will try to compensate (part of) the excise tax raise by reducing their prices.

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Appendix

A. Project team

The project team was constructed to provide feedback and to keep track on the timeline/progression of the study. The project team included the clients (KWF & ANR) and authors of the report. The project team consisted of:

Dr. Reina de Kinderen (Maastricht University)
Drs. Ben Wijnen (Maastricht University)
Prof. dr. Mr. Silvia Evers (Maastricht University)
Dr. Paul van Gils (RIVM)
Drs. Mark Monsma (ANR)
Prof. dr. Marc Willemsen (Maastricht University / ANR)
Drs. Nicole van Loy (ANR)
Drs. Fleur van Bladeren (KWF)
Mr. Tim Rombouts (KWF)

B. Expert group

The expert group gave advice regarding the strategic positioning of the SCBA and consisted of the following persons. Expert group meetings were held 3 times and consisted of:

Drs. Chiel Bos

Prof. dr. Rutger van der Gaag

Ir. Hans de Goeij

Prof. dr. Louise Gunning

Drs. Floris Italianer

Prof. dr. Johan Mackenbach

Drs. Rien Meijerink

Dr. Alexander Rinnooy Kan

Drs. Michel T. Rudolphie, MBA

Drs. Michael Rutgers, M.sc

Prof. dr. Paul Schnabel

C. Consultation group

The role of the consultation group was to provide feedback from different relevant sectors (e.g. employees and health insurance companies). The consultation group consisted of:

Drs. Ellen Burgering

Drs. Frido Kraanen

Dr. Madelon Johannesma

Drs. Mariska Koster

D. Models considered for study

	Smoking Prevalence	Total Mortality	Total Morbidity	Disease-specific mortality	Disease-specific morbidity	QoL / Utility
CZM	Y	Y	Y	Y	Y	Y
SimSmoke	Y	Y	N	N	N	N
Mendez model	Y	Y	N	N	N	N
CISNET	Y	Y	N	N	N	N
POHEM Model	Y	Y	Y	Y	Y	N
EQUIPT	N	Y	Y	Y	Y	Y
DYNAMO-HIA	Y	Y	Y	Y	Y	N
HEM	Y	Y	Y	Y	Y	Y
OneHealth Tool	Y	Y	Y	Y	Y	N
NICE ROI	Y	Y	Y	Y	Y	Y
Benesco	Y	Y	Y	Y	Y	Y

Y= model does include this particular information; N= model does not include this particular information

	Morbidity Costs	Inter-sectoral Costs	Impact interventions	lifetime horizon	Practical	Available	Dutch data
CZM	Y	N	N	Y	Y	Y	Y
SimSmoke	N	N	Y	Y	Y/N	Y/N	Y
Mendez model	N	N	N	Y	N	N	N
CISNET	N	N	N	N	N	N	N
POHEM Model	N	N	N	Y	N	N	N
EQUIPT	Y	N	Y	Y	Y/N	Y/N	Y
DYNAMO-HIA	N	N	N	Y	N	Y/N	?
HEM	Y	N	Y		N	N	N
OneHealth Tool	Y	N	y	Y	N	Y/N	N
NICE ROI	Y	N	Y	Y	Y	N	N
BENESCO	Y	N	Y	Y	Y	N	N

Y= model does include this particular information; N= model does not include this particular information

E. Calibration of the CDM

The CDM allows two different ways to force a change in the risk factor distribution: the first is changing the initial distribution of the risk factor before the first year of the simulations and the second is changing the transitions between the different classes of the risk factor. The first option is irrelevant in our calculations. Altering the transitions is therefore the only way to influence risk factor distributions over time in order to calibrate these distributions to a certain boundary condition, for example a smoking percentage of less than 5% by 2040. Below we explain the procedure of such a calibration.

The scenarios that required calibration of the CDM were the SimSmoke scenarios, the mass media campaign scenarios, and the smoke-free Netherlands scenarios. All of these scenarios featured less smoking in the future. To achieve a situation wherein less people smoke, the three types of transitions in the CDM could be modified in the following ways:

1- Decrease the start rates
2- Increase the stop rates
3- Decrease the relapse rates

Because we could find no evidence which of these three ways is the preferred way, we chose to implement all three ways simultaneously, and apply an identical constant factor to each of them:

$$rate = -\ln(1 - transriskscen)$$

$$rate_{start,relapse} = rate_{start,relapse}/C$$

$$rate_{stop} = rate_{stop} * C$$

$$transriskscen = 1 - \exp(-rate)$$

where “transriskscen” is the set of age- and sex-specific transition probabilities in the CDM, “rate” is the set of start/stop/relapse rates, and “C” is the aforementioned constant whose value needs to be determined so that the smoking prevalence produced by the CDM best matches the smoking prevalence of the scenario that needs to be calibrated. The modification of the transitions is implemented each year, so that in all years after 2017 the transitions are more favorable than in the year before.

Calibration to SimSmoke smoking prevalence

The constant C was set to 100 different values, in the range between 1.0025 and 1.4000. The best fit is the parameter set of modified transitions that shows the least sum of squared differences with the SimSmoke prevalence over 34 years, from 2017 to 2050, for men and women. The prevalence was

scaled before taking the difference so that relative decreases in smoking prevalence are matched (**see figure XX below**).

Calibration to smoke-free Netherlands (<5%)

The constant C was set to 100 different values, in the range between 1.0025 and 1.4000. The best fit is the parameter set of modified transitions that shows the least sum of squared differences with 5% smoking prevalence in the year 2050, for men and women.

Calibration to mass media campaign

The constant C was set to 100 different values, in the range between 1.0025 and 1.4000. The resulting smoking prevalence was first scaled to year 2017 and then compared to an annually decreasing scaled smoking prevalence. This scaled smoking prevalence decreased with either 1.20%, 3.55%, or 6.50% in each year from 2017 to 2050. The best fit is the parameter set of modified transitions that shows the least sum of squared differences, for men and women.

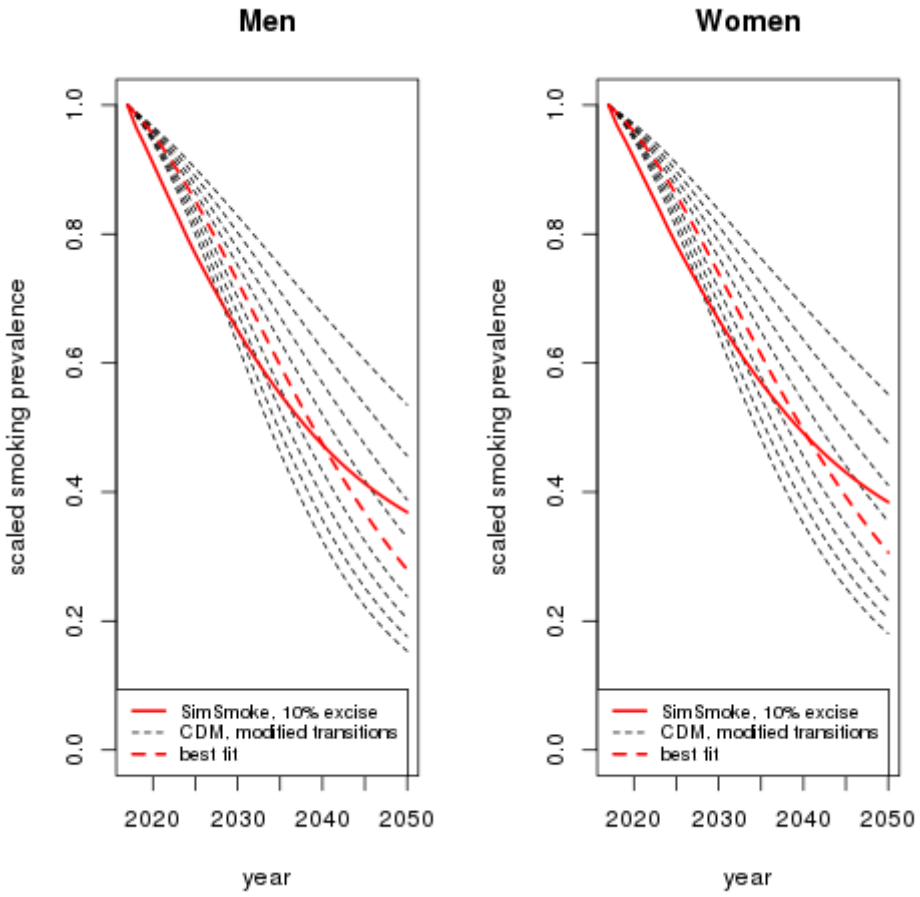

Figure D1. Smoking prevalence resulting from modified smoking transitions in the CDM and smoking prevalence from the SimSmoke model with annual 10% tax increase.

F. Calculation figures to estimate productivity losses

Adapted from Koopmans et al. [18]

Heffingen	Cost price	Cost price 2015	Reference
Nominal premium health care insurance per months (2013)	€ 92	€ 94	www.nza.nl
Obligatory excess deductible health care insurance per year (2013)	€ 360	€ 366	www.nza.nl
Payed excess deductible health care insurance per year (2013)	€ 215	€ 219	[127]
Employers costs as % of gross salary (2012)	30.9%		[128]
• Proportion employers contribution health insurance	5.6%		[128]
• Proportion employers contribution pension (2012)	10.5%		[128]
• Proportion premium WIA[23]/unemployment/other	6.9%		[128]
• Sick pay	3.8%		[128]
• Other costs (e.g. severance pay, education)	4.1%		[128]
Employees contribution pension, as % gross salary (2012)	4.8%		Based on: [129]
Tax as % gross household income (2013)	19.7%		[130]
Tax as % gross household income <65 (2013)	20.3%		[130]
• Proportion taxes	10.1%		[130]
• Proportion premium AOW[24]	5.9%		[130]
• Proportion AWBZ[25]/ANW[26]	4.3%		[130]
Tax as % gross household income 65> (2013)	15.1%		[130]
• Proportion taxes	10.1%		[130]
• Proportion premium AOW	0.8%		[130]
• Proportion AWBZ/ANW	4.3%		[130]
Income			
Net employment rate 15-65 years (2013)	73.6%		[88]
Net employment rate 15-65 years males (2013)	78.2%		[88]
Net employment rate 15-65 years females (2013)	69.0%		[88]
Gross employment income annually (2013)	€ 40,700	€ 41,363	[131]
Gross employment income annually males (2013)	€ 50,600	€ 51,425	[131]
Gross employment income annually females (2013)	€ 29,200	€ 29,676	[131]
Employees as % of total net labour force	87%		[132]
Gross annual income (2013)	€ 41,800	€ 42,481	[131]
Gross annual income males (2013)	€ 52,600	€ 53,457	[131]
Gross annual income females (2013)	€ 30,200	€ 30,692	[131]
Gross annual income 65>(2013)	€ 23,000	€ 23,375	[131]
Gross annual income 65> males (2013)	€ 30,000	€ 30,489	[131]
Gross annual income 65> females (2013)	€ 17,100	€ 17,379	[131]
Gross annual income 65> inactive (2013)	€ 21,900	€ 22,257	[131]
Gross annual income 65> inactive males (2013)	€ 28,300	€ 28,761	[131]
Gross annual income 65> inactive females (2013)	€ 16,700	€ 16,972	[131]
65> with partner (2014)	60.4%		[133]
65> with partner, males (2014)	74.4%		[133]
65> with partner, females (2014)	49.0%		[133]
% 65> households with supplementary pension scheme	90.2%		[134]
% living with financial social security 15- 65 years	3.2%		[132]
Average income from social security	€12,530	€12,530	[18]

[23] WIA: benefit for work and income according to capacity for work
[24] AOW: General Old Age Pensions Act
[25] AWBZ: Healthcare Insurance Act
[26] ANW: Surviving Dependants Act

G. Future tobacco prices and corresponding levels of excise tax and VAT

Table G1 presents future tobacco prices with 5% excise tax increase from 2017 onwards and the corresponding levels of excise tax and VAT and the annual percentage price increase

Future tobacco prices with 5% excise tax increase from 2017 onwards

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Minimum excise tax per 1000 cigarettes	181.53	181.53	190.61	200.14	210.14	220.65	231.68	243.27	255.43	268.20	281.61	295.69
Minimum excise tax per package	3.45	3.45	3.62	3.80	3.99	4.19	4.40	4.62	4.85	5.10	5.35	5.62
Retail marge*	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67
VAT per package	1.08	1.08	1.11	1.15	1.19	1.23	1.28	1.32	1.37	1.42	1.47	1.53
Price per package	**6.20**	**6.20**	**6.40**	**6.62**	**6.85**	**7.09**	**7.35**	**7.61**	**7.89**	**8.19**	**8.50**	**8.82**
Proportion excise tax	55.7%	55.7%	56.6%	57.4%	58.3%	59.1%	59.9%	60.7%	61.5%	62.2%	63.0%	63.7%
Proportion Excise tax+VAT	73.0%	73.0%	73.9%	74.8%	75.6%	76.5%	77.3%	78.1%	78.8%	79.6%	80.3%	81.1%
Proportion price increase	0.0%	0.0%	3.4%	3.4%	3.5%	3.5%	3.6%	3.6%	3.7%	3.7%	3.8%	3.8%

* estimated from Marlboro cigarette pack 19 pieces 2015, kept constant in projected years

Table continued Future tobacco prices with 5% excise tax increase from 2017 onwards

	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Minimum excise tax per 1000 cigarettes	310.48	326.00	342.30	359.42	377.39	396.26	416.07	436.87	458.72	481.65	505.74	531.02
Minimum excise tax per package	5.90	6.19	6.50	6.83	7.17	7.53	7.91	8.30	8.72	9.15	9.61	10.09
Retail marge*	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67
VAT per package	1.59	1.65	1.72	1.78	1.86	1.93	2.01	2.09	2.18	2.27	2.37	2.47
Price per package	**9.16**	**9.52**	**9.89**	**10.28**	**10.70**	**11.13**	**11.59**	**12.07**	**12.57**	**13.10**	**13.65**	**14.23**
Proportion excise tax	64.4%	65.1%	65.8%	66.4%	67.0%	67.6%	68.2%	68.8%	69.3%	69.9%	70.4%	70.9%
Proportion Excise tax+VAT	81.8%	82.4%	83.1%	83.8%	84.4%	85.0%	85.6%	86.2%	86.7%	87.2%	87.8%	88.3%
Proportion price increase	3.9%	3.9%	3.9%	4.0%	4.0%	4.1%	4.1%	4.1%	4.2%	4.2%	4.2%	4.35

* estimated from Marlboro cigarette pack 19 pieces 2015, kept constant in projected years

Table continued Future tobacco prices with 5% excise tax increase from 2017 onwards

	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Minimum excise tax per 1000 cigarettes	557.57	585.45	614.73	645.46	677.73	711.62	747.20	784.56	823.79	864.98	908.23	953.64
Minimum excise tax per package	10.59	11.12	11.68	12.26	12.88	13.52	14.20	14.91	15.65	16.43	17.26	18.12
Retail marge	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67
VAT per package	2.58	2.69	2.80	2.93	3.06	3.19	3.33	3.48	3.64	3.80	3.97	4.16
Price per package	**14,84**	**15,48**	**16,15**	**16,86**	**17,60**	**18,38**	**19,20**	**20,06**	**20,96**	**21,91**	**22,90**	**23,95**
Proportion excise tax	71.4	71.9	72.3	72.7	73.2	73.6	73.9	74.3	74.7	75.0	75.3	75.7
Proportion Excise tax+VAT	88.7	89.2	89.7	90.1	90.5	90.9	91.3	91.7	92.0	92.4	92.7	93.0
Proportion price increase	4.3	4.3	4.3	4.4	4.4	4.4	4.5	4.5	4.5	4.5	4.5	4.6

* estimated from Marlboro cigarette pack 19 pieces 2015, kept constant in projected years

Table G2 presents future tobacco prices with 10% excise tax increase from 2017 onwards and the corresponding levels of excise tax and VAT and the annual percentage price increase

Future tobacco prices with 10% excise tax increase from 2017 onwards

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Minimum excise tax per 1000 cigarettes	181.53	181.53	199.68	219.65	241.62	265.78	292.36	321.59	353.75	389.13	428.04	470.84
Minimum excise tax per package	3.45	3.45	3.79	4.17	4.59	5.05	5.55	6.11	6.72	7.39	8.13	8.95
Retail marge*	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67
VAT per package	1.08	1.08	1.15	1.23	1.31	1.41	1.52	1.63	1.76	1.90	2.06	2.23
Price per package	**6.20**	**6.20**	**6.61**	**7.07**	**7.58**	**8.13**	**8.74**	**9.42**	**10.15**	**10.97**	**11.86**	**12.85**
Proportion excise tax	55.7	55.7	57.4	59.0	60.6	62.1	63.5	64.9	66.2	67.4	68.6	69.6
Proportion Excise tax+VAT	73.0	73.0	74.7	76.4	77.9	79.5	80.9	82.3	83.5	84.8	85.9	87.0
Proportion price increase		0.0	6.7	6.9	7.1	7.3	7.5	7.7	7.9	8.0	8.2	8.3

* estimated from Marlboro cigarette pack 19 pieces 2015, kept constant in projected years

Table continued Future tobacco prices with 10% excise tax increase from 2017 onwards

	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Minimum excise tax per 1000 cigarettes	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**
Minimum excise tax per package	517.93	569.72	626.69	689.36	758.30	834.13	917.54	1009.2 9	1110.2 2	1221.2 4	1343.3 7	1477.7 0
Retail marge*	9.84	10.82	11.91	13.10	14.41	15.85	17.43	19.18	21.09	23.20	25.52	28.08
VAT per package	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67
Price per package	2.42	2.62	2.85	3.10	3.38	3.68	4.01	4.38	4.78	5.22	5.71	6.25
Proportion excise tax	**13.93**	**15.12**	**16.43**	**17.87**	**19.46**	**21.20**	**23.12**	**25.23**	**27.55**	**30.10**	**32.91**	**35.99**
Proportion Excise tax+VAT	70.6	71.6	72.5	73.3	74.1	74.8	75.4	76.0	76.6	77.1	77.6	78.0
Proportion price increase	88.0	88.9	89.8	90.6	91.4	92.1	92.8	93.4	93.9	94.4	94.9	95.4

* estimated from Marlboro cigarette pack 19 pieces 2015, kept constant in projected years

Table continued Future tobacco prices with 10% excise tax increase from 2017 onwards

	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Minimum excise tax per 1000 cigarettes	1625.5	1788.0	1966.8	2163.5	2379.9	2617.8	2879.6	3167.6	3484.4	3832.8	4216.1	4637.7
Minimum excise tax per package	30.88	33.97	37.37	41.11	45.22	49.74	54.71	60.18	66.20	72.82	80.11	88.12
Retail marge	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67
VAT per package	6.84	7.49	8.20	8.98	9.85	10.80	11.84	12.99	14.25	15.64	17.17	18.86
Price per package	**39.39**	**43.13**	**47.24**	**51.76**	**56.73**	**62.21**	**68.22**	**74.84**	**82.13**	**90.14**	**98.95**	**108.6**
Proportion excise tax	78.4	78.8	79.1	79.4	79.7	80.0	80.2	80.4	80.6	80.8	81.0	81.1
Proportion Excise tax+VAT	95.8	96.1	96.5	96.8	97.1	97.3	97.6	97.8	98.0	98.1	98.3	98.5
Proportion price increase	9.4	9.5	9.5	9.6	9.6	9.6	9.7	9.7	9.7	9.8	9.8	9.8

* estimated from Marlboro cigarette pack 19 pieces 2015, kept constant in projected years

H. Effectiveness of Mass media campaigns

From Feenstra et al. 2005:

"Based on US data, the net effect of mass media campaigns was estimated as 0.5 to 0.7 times the observed effect in time series. USA data allowed comparison to the USA average, to correct gross prevalence reductions for autonomous trends. The relative reductions in California and Massachusetts, where mass media campaigns were implemented, ranged between 9% and 23%, while the 'autonomous secular' trend in the USA was a relative reduction of about 11% during the period 1989-1993 and 3% during the period 1990-1996. Leaving out the strange results of the 94-96 campaign in California, the relative net reduction from the campaigns may be estimated by subtracting the USA trend from the trends in the campaign states, and ranged between 6% and 12% [135].

Dividing the net reduction by the gross reduction, correction factors were estimated at 0.5 to 0.7. These were then used to multiply Dutch gross effects in order to tentatively translate gross to net effects. Furthermore, the absolute net reductions in USA states with campaigns were 0.4 to 0.7 percentage points a year.

From the period 97-99 to 00-01 the smoking prevalence rate decreased by 2.2 percentage points (from 33.7% on average in 97-99 to 31.5% on average in 00-01). This is a relative reduction of 6.5%. This reduction may be seen as the 'maximum possible effect' of the millennium campaign 'Dat kan ik ook', if the whole decrease in prevalence is ascribed to the campaign. Between 2001 and 2003 the prevalence rates stabilized around 30%. In the first semester of 2004, the smoking prevalence rate decreased to 27%, while the estimated smoking prevalence for 2004 is 28%. Hence the maximum possible effect of the 'Nederland start met stoppen campaign' would be 2 percentage points. The 'average' maximum effect of the two campaigns then amounts to 2.1 percentage points. These reductions clearly overestimate the effects. Correction with the factor of 0.5-0.7 derived above leads to an estimated net effect of 1.0-1.4 percentage points for the two Dutch campaigns. Combined with the absolute net effect found for campaigns in the USA (0.4 to 0.7 percentage points a year) this leads to a range of 'most probable effect' between 0.5 and 1.0 percentage points. A (theoretical) minimum is established by multiplying the estimated effect in the Dutch situation (1.0 percentage points) by 0.2. This is based on Hu and co-authors, [136] who suggested that 20% of the effects can be ascribed to mass media campaigns, in case of simultaneous implementation of other (tax) measures. To summarize, most likely mass media campaigns can reduce the prevalence rate of current smokers by 0.5 to 1.0 percentage points. A (theoretical) minimum is a decrease in prevalence rate of current smokers by 0.2 percentage points, and a theoretical maximum for effectiveness is 2.1 percentage points."

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